

NATURAL HISTORY

THE JOURNAL OF THE AMERICAN MUSEUM

DEVOTED TO NATURAL HISTORY,
EXPLORATION, AND THE DEVELOP-
MENT OF PUBLIC EDUCATION
THROUGH THE MUSEUM



MARCH-APRIL, 1925

[Published April, 1925]

VOLUME XXV, NUMBER 2

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NATURAL HISTORY

VOLUME XXV

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Published bimonthly, by the American Museum of Natural History, New York, N. Y.
Subscription price \$3.00 a year.

Subscriptions should be addressed to George F. Baker, Jr., Treasurer, American Museum of Natural History, 77th St. and Central Park West, New York City.

NATURAL HISTORY is sent to all members of the American Museum as one of the privileges of membership.

Entered as second-class matter April 3, 1919, at the Post Office at New York, New York, under the Act of August 24, 1912.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 15, 1918.

The Invertebrate Number

Beginning with the number for May-June, 1925, NATURAL HISTORY for a period will be issued by various departments of the Museum, thus giving an opportunity to present to our readers in each case a series of articles emphasizing a special field of natural history.

The May-June number will appear under the editorship of Dr. Roy W. Miner, curator of lower invertebrates, and will be devoted in the main to these humble creatures, which constitute biologically so large a proportion of the animal kingdom. Often these creatures are of minute size and relatively unknown to many people.

Mr. Frank J. Myers will introduce the reader to those strange inhabitants of fresh-water pools known as rotifers, the animals with "wheels in their heads," too small to be seen except with the aid of a microscope, but so numerous that a drop of pond water may contain hundreds of them. Prof. Ulric Dahlgren, of Princeton, will describe the organs of hearing among some of the lower forms of life, especially the katydids, which have "ears in their shins." Mr. Herman Mueller, the expert glass blower of the Museum, will initiate the reader into the marvelous process of glass-blowing, by means of which one of the most interesting Museum groups, representing a half inch of pond bottom with its associated life magnified one hundred times, is now being constructed. Dr. Willard G. Van Name will show how in that strange group of animals, the ascidians, evolution appears to have taken a step backward. Dr. E. W. Gudger will describe some curious habits of the hunting spiders. Mr. William M. Savin will picture the remarkable moth, *Pronuba*, and its strange relationship to the flowers of the *Yucca* plant. Mr. Barnum Brown, who has just returned from a five years' journey to the Far East, will relate some of his interesting experiences in Burma, in connection with which he has brought back many striking photographs, a selection from which will be reproduced. Dr. Roy W. Miner will tell how the tiny coral animals of tropical seas gradually build up immense coral reefs to become islands fit for the habitation of man.

There will be a series of duotone illustrations depicting exhibits in the Darwin hall, noteworthy because of their beauty and faithfulness to nature.

It is hoped that in this or a subsequent number, Dr. W. K. Gregory may review Professor Osborn's new book entitled *Impressions of Great Naturalists*. This will be supplemented by a short article by President Osborn on "The Born Naturalist." The May-June number will contain also a vivid description of the animal life and vegetation of a cactus desert of the Southwest, contributed by De Lancey Verplanck.



WHERE A SHORT DISTANCE WAS A LONG WAY

In the Upper Siwaliks near Siswan an elephant skull weighing a ton was found in a place accessible only to men on foot. So that the skull might be carried out, borne on poles, a cart awaiting it a mile beyond, the winding stream bed along which the porters struggled with their load had to be filled in wherever unevennesses occurred

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VOLUME XXV

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NUMBER 2

Glimpses of India*

INCLUDING AN ACCOUNT OF THE FIELD EXPERIENCES OF THE SIWALIK
HILLS INDIAN EXPEDITION OF THE AMERICAN MUSEUM

By BARNUM BROWN

Associate Curator of Fossil Reptiles, American Museum

IN the days of clipper ships, when traveling was arduous, voyagers returning from the Far East were wont to bring back marvelous stories of the countries visited: religious rites, fakirs, gorgeous pageantries; things so different from western experience that none could hear without wishing to see. None of the tales were more startling than those coming from India.

Many of the early descriptions savor of the *Arabian Nights*, for India is typical of the East, where time moves slowly. Today is like yesterday or the day before in rural parts; hence the contrast so vivid to westerners. One may still see the same conditions that surrounded the great Mogul emperors, even back to the days of Gautama Buddha, whose cult has long since moved eastward.

We of the American Museum staff have long cherished the hope that some day our halls would be enriched from India, and the Museum explorations in China and Mongolia made it increasingly more important that we should have a representative collection of fossils from the famous Siwalik Hills of India, and the lesser known areas of Burma. The generosity of Mrs. Henry Clay Frick made these hopes possible of realization, and it was with keen satisfaction that I received the appointment from President Osborn to carry on work in these regions.

Calcutta, where I hoped to establish

relationship with officials of the Geological Survey of India, was my immediate objective, but Bombay is the first port of call from the west, and the rail journey of 1500 miles separating these great ports saves time and gives an opportunity of seeing the central part of this vast empire, remnant of ancient Gondwana land.¹

One unacquainted with India through a personal visit may think the term "empire" grandiloquent, but no other word can adequately encompass this vast area, with its 300,000,000 people, more diverse in race, religion, and language than combined Europe.

A few hours in Bombay afford time for little more than a hasty visit to the Museum of the Bombay Natural History Society, which is doing such admirable work in India, and a drive to the Towers of Silence, the Parsi place of the dead. A considerable part of the population is made up of Parsis, whose tenets are not to pollute the elements fire, earth, or water; wherefore the dead are placed in towers, to be disposed of by vultures. It was a happier thought to watch the evening strollers, the women draped in multi-colored toga-like *saris*, as brilliant as the flowers they cast upon the waters.

At first it is rather startling to learn that you must carry your bed every-

¹For a map of the ancient land masses that subsequently united to form the Asiatic continent, the reader is referred to p. 134 of the article "The Discovery of an Unknown Continent," by Henry Fairfield Osborn, *NATURAL HISTORY*, March-April, 1924.

*Illustrations by the author and by Mrs. Brown

where, on railway journeys and in most hotels. Wherever you go, there are countless servants, but none to do your bidding unless under personal hire. No white sahib may carry even a small package; indeed few want to where service is so cheap, and reduced railway fares and hotel charges are provided for servants. If your stay is long enough, by process of elimination you acquire a good retinue—cook, personal servant, and the like, *ad lib*.

Midway between Bombay and Calcutta in the Central Provinces lies the favored hill station, Jubbulpore. It was here that so long ago as 1828 a British officer, Captain (later Major General) Sleeman, first discovered dinosaur bones in India. This deposit, of middle Upper Cretaceous age,

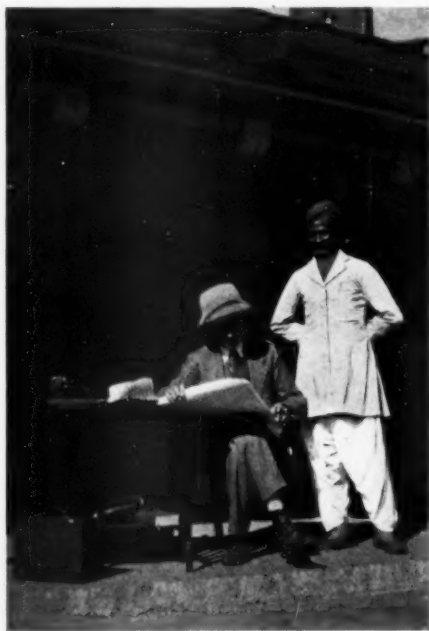
has been examined subsequently and many bones have been recovered, chiefly those of large sauropods, which are of more than passing interest from the fact that their placement indicates that the life of these giant reptiles was here prolonged to a later geologic date than is evidenced by discoveries in other parts of the world. The American Museum was enriched by representative specimens from this horizon.

The rail journey across central India is not attractive in views, nor

does one sense the density of the population in the country traversed. Most of the inhabitants cultivate the soil, but there are neither fences nor single houses to mark individual ownership. Villages upon villages, unpretentious in appearance and of monotonous occurrence;

temples far and near!

As we cross the Vindhya Mountains, not made up of peaks and jagged scarps, but harder remnants that have resisted erosion on a long, stable surface, we begin to sense the great time periods involved, and nature's influence on this passive people, whose fate it is to be born, to live, and to die in unchanged caste. From these mountains came many of the diamonds that give luster to history and fable. The "Great



Mr. Brown and his Mohammedan leader, locating the next camp.—Faithful as a right hand, punctilious as a major, solicitous as a mother, Abdul Aziz smoothed many a hard way for his master

Mogul," the "Orloff," the "Koh-i-noor," the "Pitt," all came from India.

Mr. Guy E. Pilgrim, head of the palæontological department of the Geological Survey, was away on field duty in the northern states when I arrived in Calcutta, but a letter bade me join him in camp on a date that gave ample time to investigate along the way.

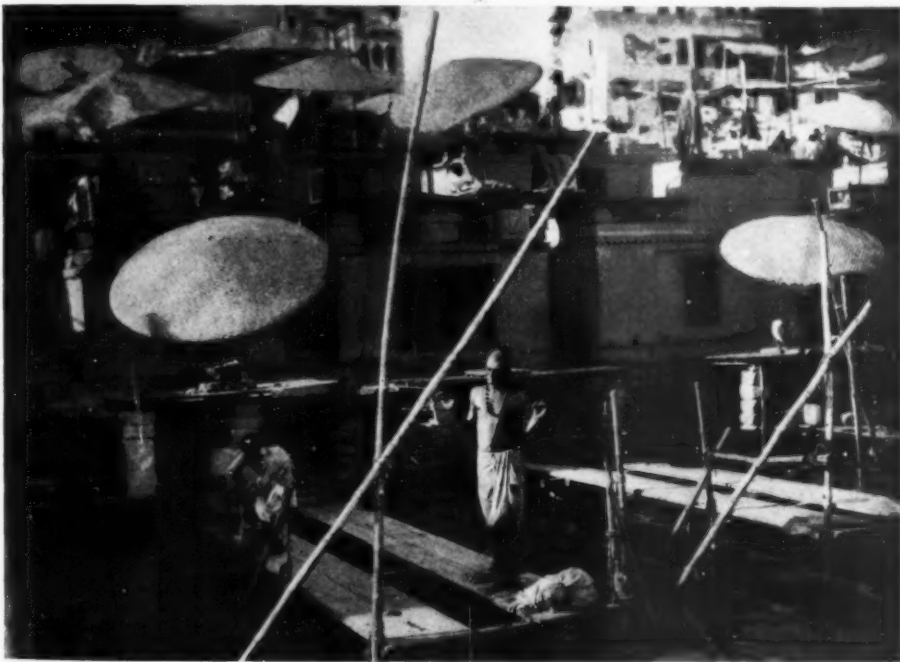
Calcutta as a municipality is no more distinctly Indian than New York is American. There are parts

purely British and parts purely Bengali, but there is little of admixture. A vibrant stir and a quickening pulse make one realize that here is the commercial center of India. The Hooghly River is filled with shipping; there are broad avenues and beautiful edifices. You pass down Clive Street, with magnificent bank buildings to right and to left, a dense moving crowd on either side; suddenly you stumble over a huge bull lying on the sidewalk chewing its cud leisurely, oblivious of the hurrying throng, and you remember that you are in the Hindu country of the Sacred Bull.

Northwest of Calcutta in the provinces of Bihar and Orissa, a night's ride by rail, lie some of India's extensive coal fields, Carboniferous and Permian in age. Overlying them are broad exposures of Triassic sand-

stones, where early Survey workers found remains of labyrinthodonts, fishes, and dicynodont reptiles. Near Asansol my search was rewarded by the discovery of bones representing most of the forms already described and some not heretofore known.

No part of India holds so much of historical interest for the traveler as the Punjab, that northern province drained by the five great tributaries of the Indus, and the United Provinces watered by the Ganges. It was in the latter region on the banks of the Rohini, not far from the present city of Gorakhpur, that Gautama Buddha was born between five and six hundred years before Christ. A few monuments and building basements made by his faithful followers are still to be seen at Sarnath, near Benares, and at Taxilla, near Rawalpindi; but here



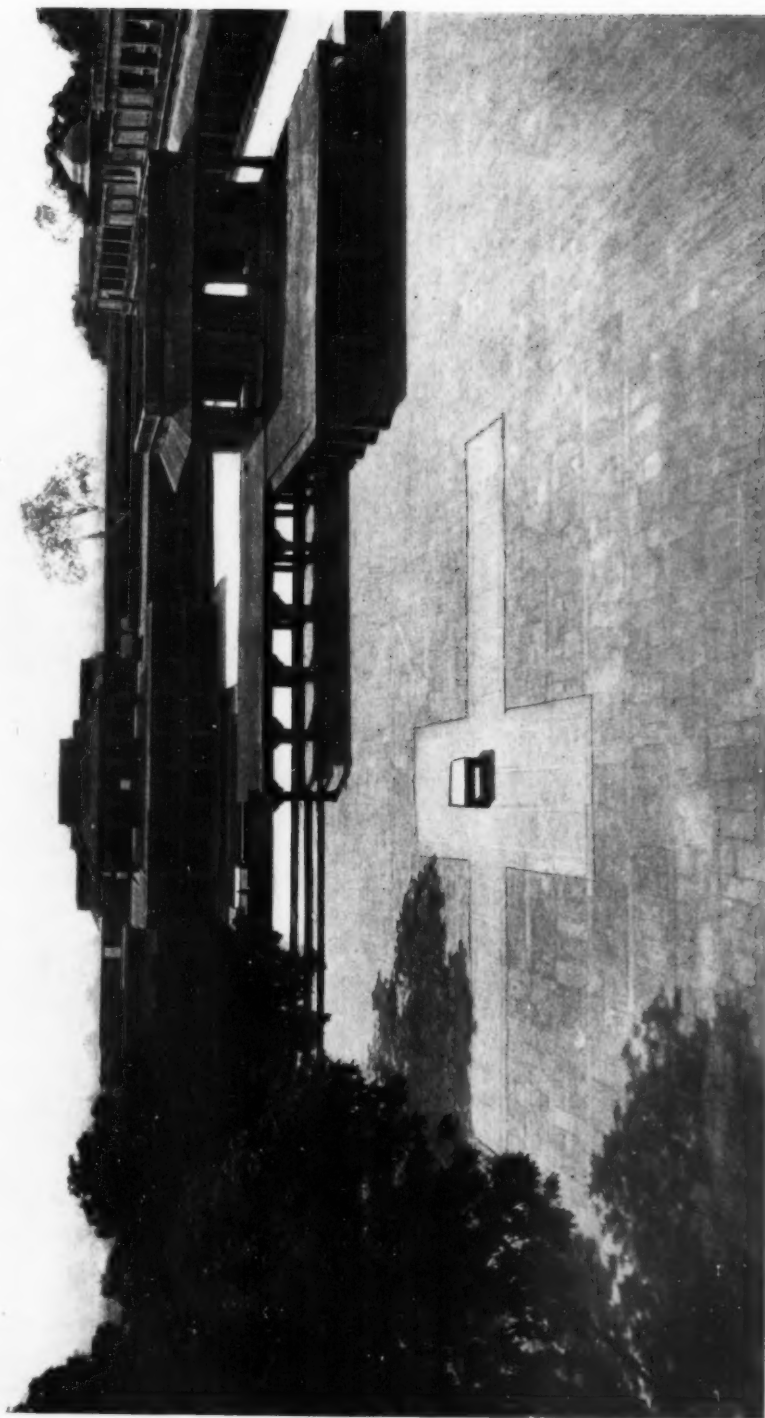
A section of the waterfront in Benares.—The ascetic in the foreground stands all day with hands uplifted, his face to the sun. Another, in front of him, remains prostrate, venerating the sacred river. Bands of pilgrims arrive constantly and the river front always presents a festal appearance



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"PEARL OF THE ORIENT"

Neither photographs nor words can adequately portray this greatest of monuments, the Taj Mahal, tomb of Mumtaz, wife of Emperor Shah Jahan. It is a fitting and perfect expression of a great love for a woman



Copyrighted 1925 by Barnum Brown

AUDIENCE HALL AND QUEEN'S APARTMENTS AT FATEHPUR SEKRI

In every detail this palace of Akbar, the Great Mogul, is as perfect as when constructed and abandoned more than three hundred years ago. From the bench in the foreground the emperor played parchisi,—his board, the pavement; his figures, slave girls

Buddhist temple bells no longer tinkle in the evening breeze.

Benares is on our way, and to visit it, is worth a long journey, even if one is not a pilgrim of the faith. To the Hindu, Benares has come to mean as much as Mecca means to the Moham-medan. We do not quarrel with the Hindu belief by saying Benares beggars description. Criticism is rather of the ignorance of the great mass of people who venerate the idols instead of treating them as symbols, as their faith teaches. The British long ago put



A human ant in the Himalayas.—With enormous weights balanced over the hips, the hill people trudge over mountain trails at elevations where walking is an uncomfortable exertion for a white man. One day Mr. Brown met a man carrying a pine log twelve feet long, squared eight by twelve inches

a stop to the practice of throwing baby girls to the alligators and burning widows on the funeral pyres of their husbands, but the burning ghats are always alight, for it is the desire of all Hindus to die and be burned here, their ashes to be scattered over sacred Mother Ganges. Golden temples;

myriads of stone temples; masses of people bathing along the river and drinking the water, while now and then a half-charred corpse floats by,—such is Benares. A holy man sits on a pier all day, dipping up water with one hand, pouring it out with the other; another sits cross-legged on a bed of spikes. You look through a temple door and see a woman pouring milk over a lingam, the symbol of Siva; another anoints it with oil; still another drapes it with flowers. One leaves Benares without regret.

Agra, Delhi, and Lahore were cities of great importance during the Mogul periods, as they are today, and the marble buildings, mosques, and mausolea scattered through this section bespeak the splendor, wealth, and achievement of their builders. No monument in existence surpasses the Taj Mahal at Agra, mausoleum of Mumtaz, wife of the Emperor Shah Jahan; it is a lacework conception in marble, perfectly executed.

The palace in the fort at Delhi conjures up the thought of its great splendor when inhabited by emperors. Delhi, the present winter capital of India, is the seventh city of its name, and in the environs one may drive through forty miles of city potter's field. Mausolea and mosques in close proximity; cities of the dead and dead cities!

A few miles away lies Fatehpur Sikri, peopled by the ghosts of yesterday; a unique city of red sandstone buildings created and abandoned by Akbar more than three hundred years ago, but still in a perfect state of preservation as though the court had left but yesterday.

Simla, in the middle Himalayas, 8000 feet above the sea, is the summer capital, where duplicate copies of

important government papers are kept, so that only the personnel needs to shift, finding in either capital the data for conducting uninterruptedly the state business. Not until a summer is spent on the plains does one appreciate this advantage of migration. The higher Himalayas rise to the north in cold grandeur, but lack the majestic peaks seen farther east. Rickshaws and ponies take the place of carriages, while heavy loads are carried by the hill people,—an admixture of Tibetans and Nepalese. One marvels at the weights carried. Boxes, bales, huge building timbers, even pianos are transported by one man. Nothing seems to daunt these sturdy human ants.

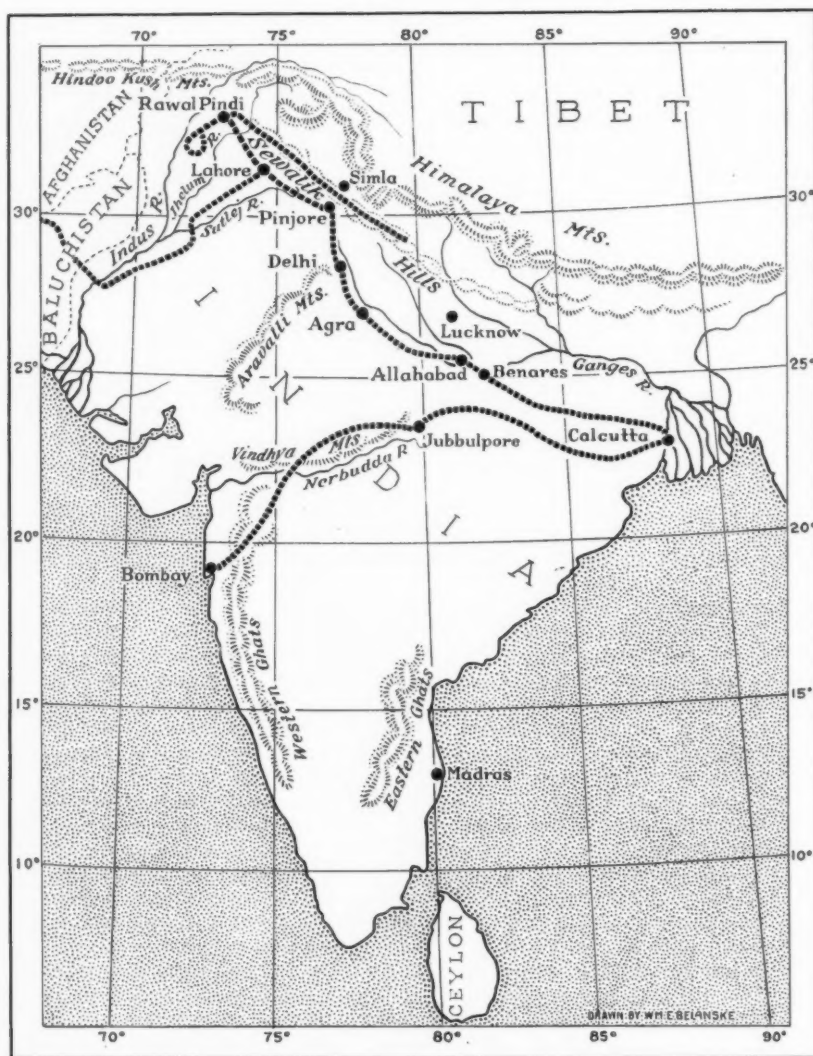
After a seventy-mile ride over low mountain ranges I joined Doctor Pilgrim in a government bungalow at Hari Talyangar, in the Bilaspur hill state. It was a pleasure to meet this distinguished gentleman who has done so much to unravel India's later geologic history. His hearty coöperation was assured, and it was of greatest importance to my work to be guided by his experience in determining characteristic rocks and their faunas, and to map out areas to be examined.

The journey across central India and along the lower ranges of the Himalayas affords a wonderful insight to its geology, the outstanding features of which are at once apparent. Briefly the Indian region may be analyzed as three distinct units: (1) a triangular mainland plateau named by the Indian geologists "the Peninsula"; (2) the mountainous region which borders it on the west, north, and east, called "the Extra-Peninsula"; and (3) the Indo-Gangetic Plain separating the two former areas. Stratigraphically and physiographically the first two divisions are entirely unlike.

(1) Since the Cambrian Period the Peninsula has been a stable land mass which has suffered but little disturbance in the great earth revolutions that have occurred from time to time. It is this part that is thought to be a fragment of a former continent called Gondwana land, which extended across the present Indian Ocean, uniting the Malay Archipelago with Australia and western Africa. Mantles of terrestrial deposits were locally distributed over parts of this area during the periods succeeding the Cambrian, and toward the close of the Cretaceous the south and central part of the Peninsula was covered by a thick series of lavas called the Deccan Traps. From the absence of craters and the horizontally-bedded sheets of material, it is evident that the eruptions came through fissures and cracks made by the movement of great earth blocks. Along the coast near Bombay the Traps reach a maximum thickness of nearly 10,000 feet and they encompass an area of 200,000 square miles, but formerly they covered an area estimated to be not less than 500,000 square miles.

Throughout the Peninsula most stratified rocks lie in a comparatively horizontal position, while mountain eminences are merely harder remnants of the surface that have resisted erosion. The rivers are shallow waterways meandering to the sea.

(2) The Extra-Peninsula, the Himalayan region, in contrast, is composed chiefly of marine deposits representing all the great geologic periods, including and succeeding the Cambrian; a comparatively weak, flexible area of the earth crust that has undergone an enormous amount of upheaval and compression during late geologic periods. All strata show high angles of dip, and extensive thrusts and faults



Map of India, showing the route of the Siwalik Hills Indian Expedition of the American Museum

attest the enormous strain to which these rocks have been subjected. The mountains are mighty serrated folds with deep transverse gorges; the rivers, rushing torrents. No less than nine of the great Himalayan peaks reach a height of more than 25,000 feet, Mount Everest, 26,002 feet, being the highest in the world. At one point in Kashmir the Indus rushes through a narrow defile between precipices 20,000

feet in height, while the river bed is only 3000 feet above sea level; thus this stupendous gorge is 17,000 feet, more than three miles, in depth.

(3) Between the Peninsula and the Extra-Peninsula lies the third great Indian feature, the Indo-Gangetic Plain, a sagging part of the Peninsula, or possibly an enormous rift fronting the Himalayas and filled in with river clays and silts that have been borne

down from the mountains by rivers tributary to the Indus and the Ganges. The abrupt termination of the foothills and the transition to far-reaching level plains in some parts of the Punjab, is startlingly sudden.

It is in this foothill region of rapidly accumulated deposits that our chief interest lies. Here and in the adjoining Salt Range were preserved the remains of the varied Miocene, Pliocene, and Pleistocene vertebrate faunas.

Having just spent a year in Africa, sometimes near the equator, I rather pooh-poohed the suggestion that a white man could not work in the open the year round in India, so much farther north. Doctor Pilgrim, however, insisted that some parts of the Punjab were hazardous for a white man in summer, especially along the Indus, so I planned to spend the remaining winter months and early spring in the Bugti section of Baluchistan, and afterwards take up the Siwalik subdivisions in succession, reserving those of the highest elevation for the hottest weather.

I again proceeded across the northern part of India to Jacobabad, near the Bugti country, where first were found bones of the gigantic Miocene rhinoceros, *Baluchitherium*.

One always writes ahead for the use of a bungalow, and from the Sibi district came word not to leave for the field until I had seen the commissioner. Arriving at Sibi during a durbar I met the nawab of the Bugtis, who at first gave reluctant permission to work in his territory, provided I took a large armed escort. This agreed to, he later flatly refused responsibility. A year before an American oil geologist, with his party, had been murdered in his territory by raiding Pathans, for which the nawab was assessed 50,000

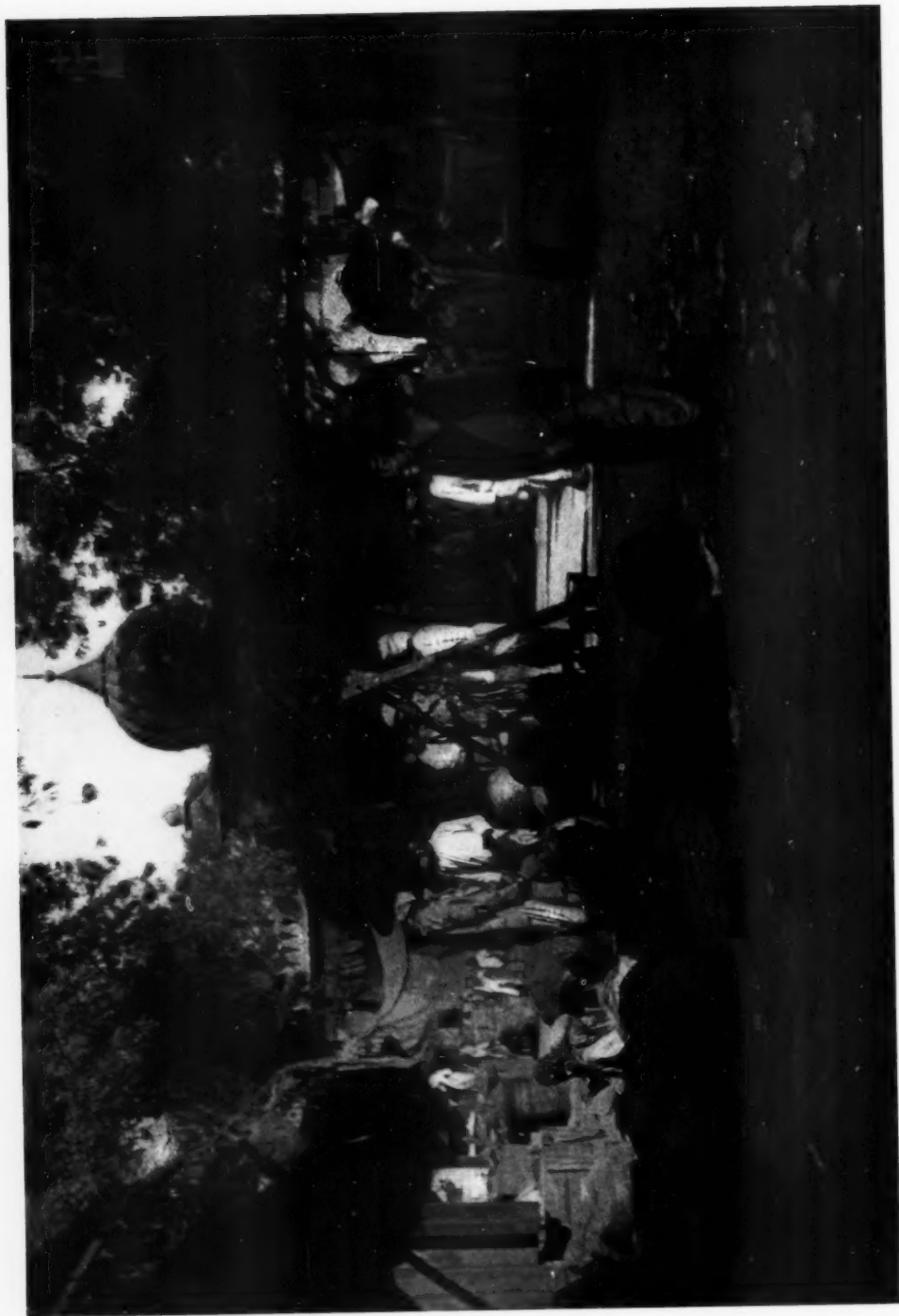
rupees, and he "didn't care to pay for another one."

I was loath to give up this part of the plan, but official correspondence with the government elicited no better results than permission to carry on the work at some future date. An expedition at the moment involved too many possibilities of a political nature.

Britain's suzerainty in India is held largely by her military administration, and her absorption of the borderlands is slow but sure. Highways and railways are built and maintained with military forethought. The borders of Afghanistan and Baluchistan on the northwest have long been the scene of conflict, for these untamed people do not take kindly to the assimilation process.

Jacobabad was long a frontier station, but now the military have moved westward, and the surrounding country is under irrigation, with ditches fed by the Indus. Magnificent neem trees contrast with the sandy desert outside, and the crops show the great possibilities of irrigation. Fat sheep and cattle and swift Arab-bred horses were a welcome sight after the underfed animals of other parts. Even the people reflect their improved condition, aside from the fact that the Baluchis and Afghans are more virile than the central Indian peoples. Temperature charts kept over a long period at this point record a usual maximum summer heat of 129 degrees. It is one of the hottest places in the world, although at the time of my visit in March it was delightfully cool.

Back I traveled to the northern sections; from Rawalpindi it was but a short distance to Chakwal, where a camel caravan was gathered for my three journeys to the Lower and Middle Siwalik exposures of the Salt Range.



THE MARKET PLACE IN JACOBABAD

The distinguished British general, John Jacob, for whom the town was named, spent many years quelling anarchy in the Upper Sind, built the Residency, and here lies buried under a massive tomb

The distinguished British general, John Jacob, for whom the town was named, spent many years in the country
built the Residency, and here lies buried under a massive tomb



THE CARAVAN OF THE EXPEDITION IN THE DILJUBBA RUKA PASS

For many miles east and west the range can be crossed only at this point, where the rock strata stand on edge

The Chakwal region was then suffering from an epidemic of bubonic plague. At such times the villagers scatter to the country, living along the trails wherever shelter is afforded.

As one journeys southeastward, the trail winds through cultivated lands, and through the pass of the Diljubba Ruka Hills, where several hundred feet of variegated marine rocks underlying the Siwalik strata are exposed. At

River, a second well-known area of Middle Siwalik exposures near Dhok Pathan.

The weather had now become excessively hot, and I was grateful to be permitted to live in a government dak bungalow, an institution worthy of mention. Throughout India, and to some extent in Burma, various government departments, such as the Police, Public Works, etc., have built bunga-



A large *Mastodon* skull in situ.—Specimens of this size were guarded from the natives night and day

Hasnot the broken country assumes a lighter orange-buff color, and in the surrounding exposures have been found many fossils of Middle Siwalik age. The ground had been worked over not long before, and fossils were not nearly so numerous as they doubtless were originally. However, skulls and jaws representing a large part of the fauna were obtained, chiefly of the smaller forms. Satisfying myself that this area had little more to offer, I proceeded northward a hundred miles to the Soan

low at points convenient for the traveler. Some are fine, costly buildings, furnished throughout and, where use demands, frequently comprising from one to six complete separate suites. By arranging beforehand any civilian may obtain permission to occupy one of these suites for a limited stay at a regulated small charge, usually one rupee per day (about thirty cents).

Some of the best fossils were found at Dhok Pathan, including horse and



The big mastodon skull starts west at last.—It took four bullocks and twenty-one men fourteen days to "worry" it to the railway, sixty miles away

Mastodon skulls, the latter presenting no inconsiderable difficulties to transport. Camels are wonderful beasts for carrying loads up to six or eight hundred pounds, but a fossil elephant or *Mastodon* skull far exceeds their capacity. Due to the rough country two of these skulls were exceedingly difficult to bring out, each requiring four bullocks to pull, and twenty-one men to push the cart in which it was conveyed after a road had been made for several miles.

The only oil so far produced in India, a limited supply, comes from the Orbitoidese measures underlying the Lower Siwaliks at Khoar, a few miles northward.

Further search at Dhok Pathan added nothing new to the collection, which now included most of the known species, and I proceeded southward to the Lower Siwalik exposures at Chenji. These strata are predominantly reddish in color, and very broken, with fossils most abundant in two upper zones stratigraphically several hundred feet apart. Vertebrate remains, however,

are found occasionally down almost to the point of contact of these strata with the underlying marine beds. The strata gradate into overlying Middle Siwalik sandstones without sign of interruption in their deposition. Few of the species are common to the overlying sandstones, but after some little experience in the field one can readily distinguish the two horizons although there are no lithological characters to separate them.

The natives cultivate patches all through the exposures and they rather resented the activities of a Sahib who went out to find fossils himself; consequently a guard had to be placed over every large specimen that required more than a day to excavate. No matter how rugged or difficult the place, I would soon see spectators perched on the high peaks, where they would remain for hours. In spite of explanations the natives could not understand why bones were collected for a museum. When asked one day what they supposed the Sahib did with



LOWER SIWALIK BEDS NEAR CHENJI

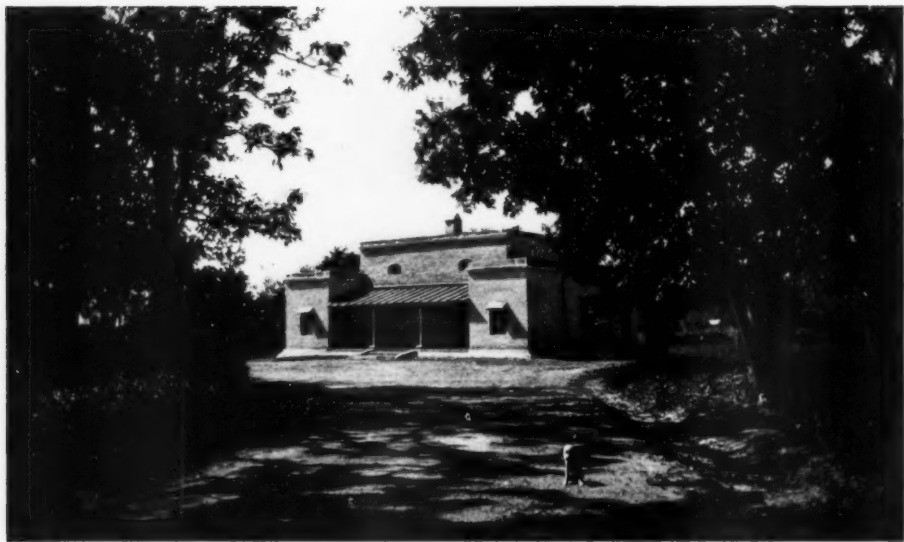
In appearance the Lower Siwaliks are not unlike bad lands in other parts of the world but are easily distinguished by their reddish appearance and fossil remains from the overlying Middle Siwaliks. Every available level place, even in this wild region, is cultivated

In appearance the Lower Siwaliks are very different from the overlying Middle Siwaliks. Every available level place, even in this wild region, is cultivated and fossil remains from the overlying Middle Siwaliks.



TOP OF THE UPPER SIWALIK BEDS AT SISWAN

Toward the close of the period represented by these beds there was accelerated elevation of the Himalayas, marked by predominant boulder and conglomerate strata clearly shown in this photograph. Few fossils are found in these strata



Public Works Department bungalow at Chandigarh.—In the early days of British administration, a departmental officer required a cumbersome outfit of tents and caravan with two complete equipments, so that whenever one camp was abandoned, another might be in readiness for him. Now fine bungalows are built at convenient points

these bones, they replied that he pounded them up for medicine—a prevalent use of fossils also in parts of China.

Having completed this part of the program, I proceeded by rail to the Upper Siwalik exposures in the Ambala district, near Kalka. It was in this area that Siwalik fossils were first found, and for many years thereafter fossils from the three divisions of the Siwaliks were grouped under the same time period, without recognition of the significance of evolutionary development in various genera.

One may better appreciate what this means from the fact that taking the places of maximum thickness of each member, the three subdivisions total 20,000 feet of sediments,—strata that are especially difficult to classify and correlate on lithological characters without the aid of fossils. This enormously thick mass of strata does not, however, represent the same time

period that an equal thickness of rock would denote elsewhere. The deposition of the beds was more rapid than that traceable in almost any other part of the world. Especially is this true of the Upper Siwaliks, where hundreds of feet of material are composed chiefly of bowlders rapidly accumulated during a period of elevation of the Himalayas. The thickness and character of the beds are explained by the height and broken nature of the mountains from which they were derived, in conjunction with the excessive rains which fall during the monsoon periods, when every water course is a muddy torrent. Micaceous material from disintegrated schistose rocks forms a large percentage of the entire Siwalik series.

The Upper Siwalik beds usually form the outer range of the Himalayas as distinct low ridges parallel to the main range, or at intervals as part of the outer flanks of the range extending from

Baluchistan to Assam. They are not, however, fossiliferous throughout their extent. One of the historic type localities is on the railway to Simla, near Chandigarh, where I made headquarters in a dak bungalow, collecting on either side along the foothills for a distance of seventy-five miles.

In the Upper Siwalik fauna elephant remains are most numerous, with those of hippopotamuses a close second, the occurrence of which gives a clew to the climatic condition of this area when the animals were alive. In other parts of the world numerous skeletons, or at least associated bones of the same individual, will be found in parts of a formation where favorable for their preservation. It was with the hope of finding such material that I spent a year and a half searching in the Siwalik measures of India, but, though isolated bones were found in numbers, during all this time only one incomplete skele-

ton, that of a camel, was secured in the Upper Siwaliks.

The faunas of the different Indian horizons are represented in the collection of the Siwalik Hills Indian Expedition of the American Museum by skulls or jaws of most of the known species and by several new species; the collection is especially rich in skulls and jaws of elephants and horses.

One of the most striking specimens is an enormous tortoise with leg bones the size of a large rhinoceros. It is incomplete, but the clean bone of the existing parts weighs no less than eight hundred pounds.

During the expedition in India two car loads of fossils were collected and despatched to the American Museum, after which another part of my program was undertaken. This was to collect fossils in the Eocene-Pliocene beds of Burma, an account of which would require another article.



Elephant skull found at Siswan in a hard sandstone concretion of the Upper Siwalik beds.—Mohammedan masons are helping to remove the matrix



THE TIGER SWALLOWTAIL, ONE OF THE NEW INSECT GROUPS

A photograph gives but a faint notion of the beauty of the exhibit with all of its natural color. Usually both sexes of this butterfly are largely yellow but frequently, especially in the South, the female is dark, as in the case of the one flying near the center of this group

The New Insect Groups in the American Museum

By FRANK E. LUTZ

Curator of Entomology, American Museum

TO show insects in an appropriate setting without having the setting swallow up the insects,—that was the problem.

An early departure from a "Noah's Ark" exhibit—insects pinned two by two, male and female, in endless array—was made when the inflated skins of caterpillars in all their sausagelike unnaturalness were glued on dried leaves. Then artificial leaves were substituted for dried natural ones and finally wax caterpillars were made so lifelike that they seemed to be eating the wax leaves upon which they rested.

But a spray of leaves does not picture the whole environment of even a leaf-eating insect. "Habitat groups" were highly desirable.

We undertook years ago to show the huge nest built by one of our local species of ants, *Formica exsectoides*. We constructed a nest about three feet in diameter, and the fact that these ants live in open woodland is indicated to the visitor who knows plants by the ferns and other characteristic vegetation surrounding the nest, but these tell little to the visitor who does not know plants. Furthermore, without a background there is nothing to bring out the fact that the home of this ant is in the hill country. Incidentally, much labor in carefully posing a hundred or more ants was largely wasted because they can scarcely be seen.

With respect to the number of biological points illustrated, one of the most successful groups ever constructed (at least of those without a

background) is that of the seventeen-year cicada, made under the direction of Mr. Grossbeck, then assistant in our department of entomology. It shows that there are two races of this interesting insect, a large one and a small one; that the immature life is spent underground; that sometimes, especially in damp places where leaves lie thickly, a clay "chimney" is built over the exit from the earthy nursery; that the wonderful change from a wingless digger to a winged creature of the free air takes place while the insect is clinging to a tree trunk or other vertical support; that the female lays her eggs in punctures which she makes in small branches, although her young must drop from there to the ground; that these punctures so weaken the branches that they are eventually broken off by high winds; that a fungus destroys many of the adults, eating off their abdomens; that the largely useless English sparrow also feeds on cicadas; and so on.

But even the cicada group is a diagram rather than a picture—instructive but not particularly pleasing to the eye. It was not until we hit upon the idea of confining the view of a group to that obtained through a relatively small opening in the front of a case that we were able satisfactorily to show insects in appropriate settings without having the settings swallow up the insects. We can now present real pictures of insect life. However, these pictures are expensive to make and space is limited. What determines our choice of subjects when we



A GROUP ILLUSTRATING THE LIFE HISTORY AND HABITS OF THE BALTIMORE BUTTERFLY



THE PLEBIAN CABBAGE BUTTERFLY, AN IMMIGRANT FROM EUROPE



THE JAPANESE BEETLE

This group shows a peach orchard being devastated by thousands of beetles whose ancestors reached this country not more than ten years ago. Such an increase in numbers was possible because of the absence of parasitic insects which prey upon the beetle in Asia



THE MONARCH BUTTERFLY

The monarch is known also as the milkweed butterfly because of the food habits of its banded caterpillar. The red and black adults fly about apparently unafraid of enemies, and in the autumn go south for the winter



LADY BEETLES, INSECT FRIENDS OF MAN, EMERGING FROM HIBERNATION ON A MOUNTAIN TOP

have half a million different kinds of insects from which to choose? Let us glance at those which have already been put on exhibition.

The life history of the Baltimore butterfly (*Melitæa phaëton*) was selected as the first subject to be shown by this new method. The picture is a moist meadow in early summer, a landscape so difficult to represent that it was a real test. A very slight "group license" was taken in order to exhibit all stages from the eggs—yellow when freshly laid, red when about to hatch—through various sizes of spiny caterpillars and the unprotected pupa to the dainty adult bearing the colors of Lord Baltimore. But, conspicuous in the center of the foreground, is a rather tight mass of dead leaves still clinging to a weed stalk. It is the main point of interest because, in the preceding autumn, several dozen young caterpillars, brothers and sisters, had fastened those leaves together with silk spun from their mouths and had passed the winter in that thatched hut. Such a family hibernaculum is unusual.

We talk of "cabbages and kings" even in entomology. Standing next to the meadow of the Baltimore is a neglected cabbage patch in which an early immigrant from Europe, our now common cabbage butterfly (*Pieris rapæ*), has made itself at home and we shall come later to the "monarch."

The European cabbage butterfly was accidentally brought to America at about the time of our Civil War and, though but a medium-sized butterfly with a naked caterpillar, it started an invading march that has not only pushed our native cabbage-eating butterflies almost out of existence—at least, as far as our garden patches are concerned—but has cost our gardeners many hundreds of thousands of dollars.

Why it should have been so successful we do not know; but certainly its success would have been even greater had it not been for parasitic insects which attack it and keep its abundance within at least reasonable limits. Cocoons of some of these parasites are shown in our group just as they were spun after the parasitic larvæ had left the caterpillar which they had killed. The various stages in the life of the butterfly are also shown and the observant visitor will note that some of the adults (the females) have one more spot on each front wing than the other adults (the males).

The tiger swallowtail (*Papilio glaucus*) is the most gorgeous of our Northeastern butterflies when it is in its yellow clothes. This yellow is always worn by the males and, in the North, usually by the females; but sometimes in the North and often in the South the female puts on a dull dark-brown or blackish dress. Why this change we do not know; but our group shows both forms of the adult. It also shows the curious and rather luxurious caterpillar on its favorite food plant, wild cherry. "Curious," because of the pair of eye-like spots on its thorax and the pair of "horns" that may be thrust out or withdrawn, apparently depending upon whether the caterpillar wishes to frighten an intruder or not. "Luxurious," because of its habit of making a hammock upon which to rest when not feeding. It does this by spinning a sheet of silk so tightly over the top of a leaf that the leaf is bowed.

Then we have the monarch (*Danaus archippus*). Instead of enduring our northern winters, these butterflies gather in great flocks in early autumn and leisurely migrate to the South. Part of such a flock, ready to begin

the migration, has been on exhibition for some time in a large case at the entrance to the hall of insect life. Next spring a few individuals return to start a new generation. The caterpillars, banded with black and green and having a pair of threadlike appendages at each end of the body, feed upon milkweed and are there rather conspicuous objects, apparently unafraid of enemies. The newly formed pupa is indeed a beautiful object and has been aptly described as "a green house studded with golden nails." This "house" darkens as the inmate takes on the adult coloration of red and black. Man has come to associate red with danger. Whether or not this be the reason that man believes red to be a warning color in nature, the theory is that the monarch adult is distasteful to birds and by its color warns the birds not to try to eat it.

We have another butterfly that is about the size of the monarch and has almost identical red and black markings. It is believed that birds find it quite edible and the theory is that its color, "mimicking" that of the monarch, is for the purpose of deceiving the birds into thinking that it is distasteful. At any rate, the mimic is an interesting insect and we hope to exhibit its life history in a habitat group before long.

The Baltimore group showed a family winter quarters, and its meadow habitat tested our method of exhibition because of its flatness and the danger that the small insects would be lost in the abundance of vegetation. Monarch butterflies gather in flocks and go south before winter comes. Adult lady beetles also gather in numbers for the winter but they huddle together under bark, or in a rocky crevice, or in some other protected place. In the

mountains of our West these numbers are often immense, the insects flying long distances to congregate on some mountain top. It has been my good fortune on several occasions to see these beetles coming out of their winter sleep aloft and I wanted others to get a picture of this stirring sight. Could we show the beetles swarming over the rocks and still give the impression that these rocks are the top of a peak?

Each visitor looking at our group of lady beetles on a Colorado mountain can judge of our success and each one seeing these beetles should remember that lady beetles are exceedingly beneficial to mankind and, indeed, to all the higher animals. As larvæ and as adults, except for a few renegade kinds that we shall exhibit later, they spend their lives eating the plant lice or scale insects (as the case may be) that are so destructive of vegetation.

Not all insects are pests. In the cabbage patch we show a parasitic insect that is helping to keep the European cabbage worm in check, and our country has thousands of kinds of insects which guard our fields and forests against an undue increase in the native insects that feed upon our plants and trees. This is the "balance of nature," and insects are largely balanced by insects.

But man, with his commerce, is continually upsetting this balance, as was the case when a Japanese beetle (*Popillia japonica*), now known to us as *the* Japanese beetle, came to the vicinity of Philadelphia, in the earth about the roots of some imported Japanese shrubs. The presence of this beetle in America was first discovered in 1916. Now, lacking its insect enemies that held it in check in its original home, it has increased to

almost unbelievable numbers and is extending its range in the United States. Our latest habitat group shows these aliens in a peach orchard and the exhibit gives at least a faint notion of the menace this beetle represents.

These are the insect habitat groups that have been installed within the last two years. Our idea of a relatively small window restricting the view has been a success. Thanks to the skill of Messrs. Burns, Jansen, and others

working under the direction of Mr. James Clark, the groups are natural and beautiful pictures, and the aim of the department of entomology has been to make each one show interesting features of natural history,—something that is either a striking biological phenomenon or of economic importance to man. In this way the exhibits are truly both beautiful and instructive, and our insect exhibition hall is becoming a hall of insect life.



Reproducing the Rockies in order to show lady beetles emerging from a winter sleep on a mountain top.—At the left Mr. A. A. Jansen is shown painting the background, and at the right Mr. E. J. Burns is seen working on the rocks that form the mountain top in the foreground. Note in each case the small sketch model of the proposed exhibit. See also the illustration of the completed group, page 132

Old-Time Range of Virginia Deer, Moose, and Elk

By GEORGE BIRD GRINNELL

THE former abundance of North America's big game is hardly realized today. Accounts of the enormous numbers of buffalo and other game make little impression on us. We who have never witnessed anything with which we can compare what is described, cannot picture the scenes.

Scattered writings of recent years contain many interesting references to former game plenty; but besides these, buried in old books of travel and discovery, are other accounts, even more interesting, which to many of us are unknown. Then, too, hidden away in the memories of a few living men, are recollections of game plenty seen with their own eyes, which have not been recorded.

Of the big-game hunters and field naturalists of the present day, who must go far in order to put in practice their skill in hunting or in the use of the rifle, or their observation of big game, not a few, I think, will feel an interest in these random notes about some of our game animals.

Naturalists and outdoor men feel keen regret at the passing of the wild things, so beautiful and so admirable under natural conditions. The disappearance of the wild creatures from most of the land is a loss—a loss in beauty and a loss to civilization, which they benefited in many ways. Yet fortunately some of them are being preserved and will no doubt endure for generations; and in the national parks and forest reserves of the United States and Canada, the children and grandchildren of those

who used to hunt them may continue to see examples of many of our most splendid forms of wild game.

WHITE-TAILED DEER

Notwithstanding the pursuit to which it has always been subjected, the familiar Virginia deer still persists in many thickly settled regions. Where it is provided with proper range and protection, it does well and increases. Occasionally it is even propagated in semi-domestication for food.

Formerly abundant from the Atlantic Coast to the Rocky Mountains, Mexico, and California, its range on the Atlantic seaboard has of late years extended far to the north and east. It was long supposed that it had not inhabited Nova Scotia until introduced there about 1888. Recently, however, some remains of this animal were found in two widely separated prehistoric shell heaps, and the bones were identified by anatomists of the Geological Survey of Canada, which identification, it is understood, was later confirmed by Dr. Gerritt S. Miller, Jr., of the United States National Museum.

A point of interest in connection with this species is that it was perhaps the first of our big-game animals in behalf of which serious efforts at protection were attempted. Nearly sixty years ago the Hon. Clinton L. Merriam, of Locust Grove, Lewis County, New York, became greatly interested in the deer of the Adirondack region, which were being destroyed in great numbers. At the time wolves and panthers still existed in the Adirondacks and killed

many deer, but the chief slaughter was wrought by the residents. During the deep snows of winter, when the deer found it hard to get about, these residents chased them with dogs and, following the dogs on snowshoes, killed the defenseless animals with clubs. Driving deer into the water with dogs in summer and killing them while swimming, was then—and for many years afterward—a recognized method of hunting.

In his efforts to lessen the destruction of these animals, Mr. Merriam appealed to the New York Association for the Protection of Game, and in a letter written in March, 1869, to Royal Phelps, its president, Mr. Merriam urged the introduction of a number of amendments to a game bill then before the New York Legislature. Among other things, these amendments provided for a bounty on wolves, the closing of still hunting December 25, prohibition of trapping deer, and the imposition of a heavy fine for each offense when a railroad received as freight venison killed in New York after January 15.

While at the time Mr. Merriam's efforts did not accomplish great things in the way of further protection of deer by law, they did much to educate the people of the Adirondacks and the general public. He vigorously agitated the question of the protection of the local deer, and, I think, was the first man who took active steps to save the Adirondack deer. In one form or another, most of his recommendations were later incorporated in the laws of New York.

In that year (1869) Mr. Merriam estimated that the deer in the Adirondacks numbered 5000 and he feared their early extermination there. Today it is believed that there are 50,000

deer in the region, and that during the hunting season of 1918, deer to the number of 15,000 were killed.

MOOSE

The range of the moose extends, with some interruptions, from the Atlantic to the Pacific but the animal is chiefly represented in Canada. It was, and is, more or less abundant in Nova Scotia, New Brunswick, and Maine, in the District of Gaspé, and on the north side of the St. Lawrence River, abundantly as far east as the Saguenay and, formerly, east of that, almost or quite to the Godbout River, according to the relation of Father Albanel. It was formerly found in great numbers in New Hampshire and Vermont, and the Reverend Nathan Perkins, who in 1789 made a trip to the new settlements in that state, wrote "Moose plentiful on ye mountains over against Jericho, Essex, and Colchester—people hunt them—eat them in lieu of beef—and get their tallow. Bears and wolves plenty." They were found occasionally in the Berkshire Hills of Massachusetts. In the Adirondack region they were well represented, the last one apparently having been killed there in 1861.¹ They occurred in the northern peninsula of Michigan and in Wisconsin, are still found in Minnesota, and again in the Rocky Mountains from northern Wyoming—one was killed near the North Platte River—northward in suitable situations, and become very abundant and very large in Alaska.² The Yellowstone Park has long been known as one of the southernmost points in the Rocky Mountains where moose were abundant, and only a

¹Efforts to reintroduce the moose in the Adirondacks have not been successful nor did the animals do well in the Corbin Preserve in New Hampshire. Those placed there have disappeared.

²There is a moose head from Alaska in the Field Museum of Natural History at Chicago, the antlers of which measure more than six and one-half feet in spread.

dozen years ago the Hon. George Shiras 3d discovered that they were extraordinarily plentiful in the valley of the Yellowstone River, just where it comes out of the mountains and enters Yellowstone Lake.

Their extraordinary number in primitive times is indicated by the report of Nicolas Perrot, who says that in the winter of 1670-71 the Saulteur Indians "secured more than two thousand four hundred moose in an island called Isle des Outaouas,"¹ which extraordinary catch of game was made only with snares. Such snares were nooses of rawhide set in openings in a sort of fence made of trees and poles loosely planted in the ground; the animal, running its head into the noose, pulled up the post to which the line was tied and dragged it along, until finally the post struck some resistant growth, the line was held fast, and the moose was choked to death. In other places, and at other times, the Indians killed moose with guns or arrows, but in winter, when the snows were deep, they pursued them on snowshoes and dispatched them with lances. This method, according to the *Jesuit Relations*, was practiced everywhere in the country of the moose.

Moose adapt themselves readily to changed conditions and still flourish in parts of eastern Canada which are sparsely populated. In recent years they have greatly extended their range in the Northwest Territories and Alaska, and are now common in the delta of the Mackenzie River. They pay little or no attention to the signs of civilization and, unless overhunted and driven away by lumbering operations, tend to hold their own in point of numbers. The settlement of many portions of Canada will be gradual and

¹Manitoulin Island.

we may expect to see the moose an inhabitant of the northern part of North America for many years.

ELK

The elk had the widest distribution of any of our large hoofed game animals. In one form or another it was found from the Atlantic to the Pacific, and from latitude 59° in western Canada south into Arizona and New Mexico. From the St. Lawrence River and Quebec on the northeast it extended south at least as far as North Carolina and Georgia, and from there westward it was very abundant.

The *Jesuit Relations*, speaking of the country along the St. Lawrence River, contain frequent references to "wild cows," "a kind of cow that appears to have some affinity with ours," and so on. Elk are commonly spoken of; but this is the French *élan*, which is, of course, the elk of Europe and the animal which we Americans call by its Indian name, moose.

A passage in the *Jesuit Relations* for 1646, by Fr. Hierosme Lalemant describes in the following language four species of deer found in the valley of the St. Lawrence between Quebec and Montreal:

There is found here a species of deer, different from the common ones of France. Our French call them "wild cows," but they are really deer; their branching horns have no likeness to the horns of our oxen, and their bodies are very dissimilar, and of much greater height. These animals go in troops; but, to assist one another, during the winter, they follow one after another, the first ones breaking the way for those that come after; and, when the one which breaks and opens up the snow is tired, it places itself last in the beaten path. The deer in France do the same in crossing a river, when they happen to be in a herd. According to report, these animals hardly stop in one place, continually travelling within these great forests. The Elks do the contrary; though they walk together, they

observe no order, browsing here and there, without straying far from the same shelter. This is what prompted, some days ago, a Savage who wished to become sedentary, to say that the Elks were French, and that other sort of roving deer, Algonquins; because the latter go to seek their living hither and thither within these great forests, and the French are stationary, tilling the earth at the place where they make their abode. Besides these deer, there are two other species—one of which is similar, or which has much likeness, to our deer of France; the other of which is believed to be the Onager or wild ass of the Scriptures.

The description of the "wild cows" with their branching horns, their height much greater than a domestic cow, and their method of breaking a way through the snow can only, it seems, apply to the wapiti. The elks spoken of are our moose. The species of deer "which has much likeness to our deer of France" may very well be the Virginia deer, while the "Onager or wild ass of the Scriptures" is the caribou. This name was applied to that species by Sagard, *History of Canada*, 1636, p. 750, and by La Hontan.

From what we read in the *Jesuit Relations* it seems, then, that the wapiti must have been abundant in the open country along the St. Lawrence River down below Montreal. Hind in his *Labrador Peninsula* quotes a statement that the elk (wapiti) persisted on the Saguenay until 1823, when the last survivors were killed by the Montagnais Indians.

The wapiti was not in old times an inhabitant of the dense woods, and may never have been abundant in the heavily forested New England hills, though it was no doubt found in open valleys. At certain points in New York it did occur, and in abundance. La Hontan in a letter dated May, 1687, describes the process by which

the natives drove *cerfs* (La Haye, 1703) or harts (London, 1735) into a pound, and gives an engraving which shows the animals being forced into an enclosure. This occurred somewhere near Lake Champlain.

Major William Austin Wadsworth had for many years at his home in Geneseo, New York, two pairs of elk antlers which, it is believed, were taken somewhere in the Mohawk Valley, perhaps near the junction of the Mohawk River with the Hudson. These antlers, Major Wadsworth told me, came from Col. Walter S. Church, a good part of whose life was spent near Albany and west of that city, and Major Wadsworth believed that they were taken somewhere in that general region. Colonel Church presented the antlers to a relative of Major Wadsworth, when the latter was a youngster, perhaps between 1850 and 1860. Colonel Church was born probably between 1810 and 1820.

Dr. C. H. Merriam in his *Mammals of the Adirondacks* presents traditions of the occurrence of elk in that region and mentions the discovery of antlers there. He is inclined to doubt the accounts given by De Kay of elk having been killed there between 1830 and 1840, for he could find no Adirondack hunters, however aged, who knew of such happenings.

Many years ago I was told of the finding of a pair of elk antlers which had been recovered from the bottom of a small pond in central Vermont. A note of the discovery was published in *Forest and Stream*, March 11, 1899, Vol. LII, p. 185.

According to McAtee, elk were found in historic times in or near what is now the District of Columbia. About the year 1775 Bartram speaks of them as being at the heads of certain rivers

of North Carolina and Georgia. Until after the Civil War they persisted in Pennsylvania, and it is believed that the last one was killed in that state in 1867.

As the country became thickly populated and communities pressed farther and farther westward, the elk, of course, retreated before them. Nevertheless, in Michigan there were elk certainly as late as 1874, and probably well into the decade between 1880 and 1890. In 1870 there were elk in Iowa, where I saw them, and in northern Minnesota they lasted almost to the beginning of this century. When the Union Pacific Railroad was built through Nebraska, elk were abundant on the plains, and in 1868 they were killed within sixty-five or seventy miles of the city of Omaha, while in 1873 they were abundant on Cedar Creek and on the Loups, and were found at the head of forks of the Loup River as late as 1880.

In these modern days we read of the elk as found only among the mountains and the timber, and some young people may think of it as a mountain animal—one that dwells in the forest. As a matter of fact, the elk of old times was quite as much an animal of the open country, the plains, the high plateaus, and the naked bald hills. If alarmed, it plunged into timber or thickets, but it loved the open.

Some years ago, when the establishment of a game reservation for wild birds and animals in Nebraska was being discussed, some naturalists expressed doubt as to whether the elk could live on the plains. In other words, the fact that the elk is naturally an animal of the open land and not merely of the densely forested country, had been entirely overlooked or forgotten by some of the men of today. Yet in my youth the whole of the

western plains was a resort for elk, which lived in part also in the timber and willows along the river bottoms. In the Yellowstone Park today elk are found in the open, which is where they feed and live; but, if frightened, they run into the timber or the brush, where their enemies lose sight of them and they lose sight of their enemies.

Up to about 1890, great herds of elk collected each winter on the bare rolling country of the central plateau east of the Continental Divide and in the eastern foothills of the Rockies. This country was high and cold, but was exposed to the wind and was largely free from snow. The elk would come down from the high mountains, where the snow lay deep, seeking the warmer broken country, where the soil was exposed and food accessible. Practically all the elk in the southern and southeastern portions of the Yellowstone Park and in the Wind River Mountains came out to this open country to winter, and for a few years after the white settlers began to arrive, they were little disturbed.

For the elk of the farther western plains and the foothills of the Rocky Mountains, the high, open valleys and meadows, and the high, bald hills of the Continental Divide were a great summer range. Thither they went in spring from their wintering grounds below, the bulls in bands seeking the highest points, to get away from the flies and mosquitoes while their horns were growing; the cows, in groups, also went to the high country, but not so high as the bulls, had their calves there, and then again collected in loose herds, which kept together until early autumn.

The region which is now the Yellowstone National Park has long been under observation, and the migratory

movements of the elk in that section have for many years been well understood by some naturalists. Early in September, depending somewhat on the first advent of cold and snow in the high regions, the elk began a movement from summer to winter range,—a general migration, in which all moved down from the high mountains. Very rarely a few animals delayed their departure too long and were snowed in and forced to winter on the heights and often to starve. I recall many years ago learning of a few bulls that were so caught in the Hayden Valley and stayed there all the winter, some or all of them dying of starvation.

The elk from the Continental Divide in the Yellowstone Park country had regular migration routes which followed down the different rivers and came out either on the lower country of the plains or on the open wind-swept spaces of the high central plateau. The elk on the east and north sides of the present Yellowstone Park moved east down the Yellowstone River as well as Clark's Fork, both branches of the Stinking Water, now called Shoshone River, and down the Grey Bull and Wind rivers. Some of these elk, when they reached the plains, went as far east as the Bighorn Mountains, and wintered in their foothills.

West of the Continental Divide a part of the elk followed down the Madison River toward the Three Forks of the Missouri and wintered in that lower country. Those to the south of the Continental Divide—the Heart Lake, Lewis Lake, and Shoshone Lake country—migrated southward along Snake River, part of their number passing over the Divide between Snake River and Green River at various low points, following down tributaries of the Green River, and thence working eastward to

the wide flats and bad-land country of the Red Desert, and east and south of that. In various sheltered spots in this plateau country, which extends for many miles east and west, elk wintered in great numbers. They were found by thousands in many places of limited area where food was abundant or near which it was accessible in favorable weather.

Many years ago, while traveling in September through the country south of the Yellowstone Park, I saw the beginnings of the individual migration southward of the elk. From all the hills along the valleys through which we rode were trails in the snow showing where single elk had passed during the night, all the trails converging toward what represented the easiest way through the country, and at last making a well-beaten road.

The number of these individual trails, plainly visible everywhere and through the glasses often traceable for a long distance up the mountain-sides, was very great, and all the trails headed in one direction,—southward for the lower country where food was plentiful, the snow less deep, and where for unnumbered generations the elk of this part of the Rocky Mountains had spent the winter.

In early days I used to be much at my ranch near a part of this wintering ground, and not infrequently rode through Bates' Hole, where there were thousands of these elk. There they remained until the approach of spring, when the snow had melted, the worst cold had passed, and the early spring rains had begun. By this time the bulls had shed their horns, and in May they began to drift back toward the higher country and were often seen. The bulls moved by twos and threes, and the movement was slow; they followed up

the snow as it melted, feeding on the old grass, for as yet the new growth had not begun.

Before 1890, however, a movement of cattlemen had started from the country of the lower plains. Many of the ranges there had been stripped of much of their herbage and the cattle no longer did as well as formerly and were moved either north to Montana or into the higher country to the west, which up to that time had been more or less free from cattle. Before this a few sheep also had been brought into this upper country and, with the gradual influx of cattle and sheep and people, there came to be some interference with the winter range of the elk. Soon after this, too, people from east of the mountains and from Colorado learned of some of these wintering grounds and began to come up in the late autumn to kill elk and load up their wagons with meat for the winter. This movement spread very rapidly, and in a short time so many meat hunters came to the particular country just spoken of that all the elk that wintered there were killed off, and the next year there were none at all—to the great disappointment and surprise of the hunters who came up for their meat.

Meantime, the Yellowstone Park country had been surrounded on the north, west, and east by ranches. Settlement on the south side came somewhat later. At first there were

only a few prospectors looking for gold on the tributaries of the Snake River, but the stories they took back brought into the country a few settlers, some of whom cut hay there for their cattle. So long as these settlers were but few, they obtained what meat they needed from the passing elk herds and did not interfere with the migration, but after some years the settlers had so increased that they put up fences which barred the ancestral migratory road of the elk to the south. Then began the starvation of elk about which of late years we have heard so much. It is obvious that the destruction caused by this starvation has far exceeded the killing by all classes of hunters.

While the elk spend their summers in an absolutely protected area, they must leave it when the heavy snows come. The park is a rectangle straddling the continental divide, and surrounded by fenced ranches, beyond which the elk cannot pass. They are shut up in a territory where there is not enough food for them, and so in winters of heavy snowfall they must starve. I believe that the number of calves born each year after the animals have gone back to their summer range exceeds the winter's loss, and that the elk herds are slowly increasing, but in the area they occupy their food is not increasing but is growing less. The future of these elk is, therefore, entirely uncertain.

Cats as Fishermen

By E. W. GUDGER

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SOME months ago I published in *NATURAL HISTORY* an article on "Dogs as Fishermen," and at the time the editor asked me if I could not prepare a similar article on "Cats as Fishermen". As it happened, I had a considerable amount of data on hand. To this other accounts have been added and the present article is the result.

My readers, who have watched puss after a rain daintily picking her way down the sidewalk or across the street, may be pardoned some feeling of surprise on reading the heading of this article. And yet is it not a truism that cats and goldfish do not flourish together even in the "best regulated households?" Unless it be catnip, there is nothing on the earth or in the waters under the earth for which cats have such a violent fondness as for fish. Undoubtedly some of the readers of *NATURAL HISTORY* have had that calamity happen which almost inevitably comes to pass when puss, left alone in a room with a bowl of goldfish, gently inserts a hooked paw and deftly abstracts one of the finny inhabitants. However, retribution sure if not swift sometimes overtakes the purloiner, and the poet Gray has celebrated in verse the demise of such a cat. In trying to remove the goldfish, puss overreached herself, fell into the glass vase and, unable to get any foothold on its smooth high sides, was drowned. Gray notes that she rose eight times and succumbed to the ninth sinking—her ninth life presumably being extinguished under water.

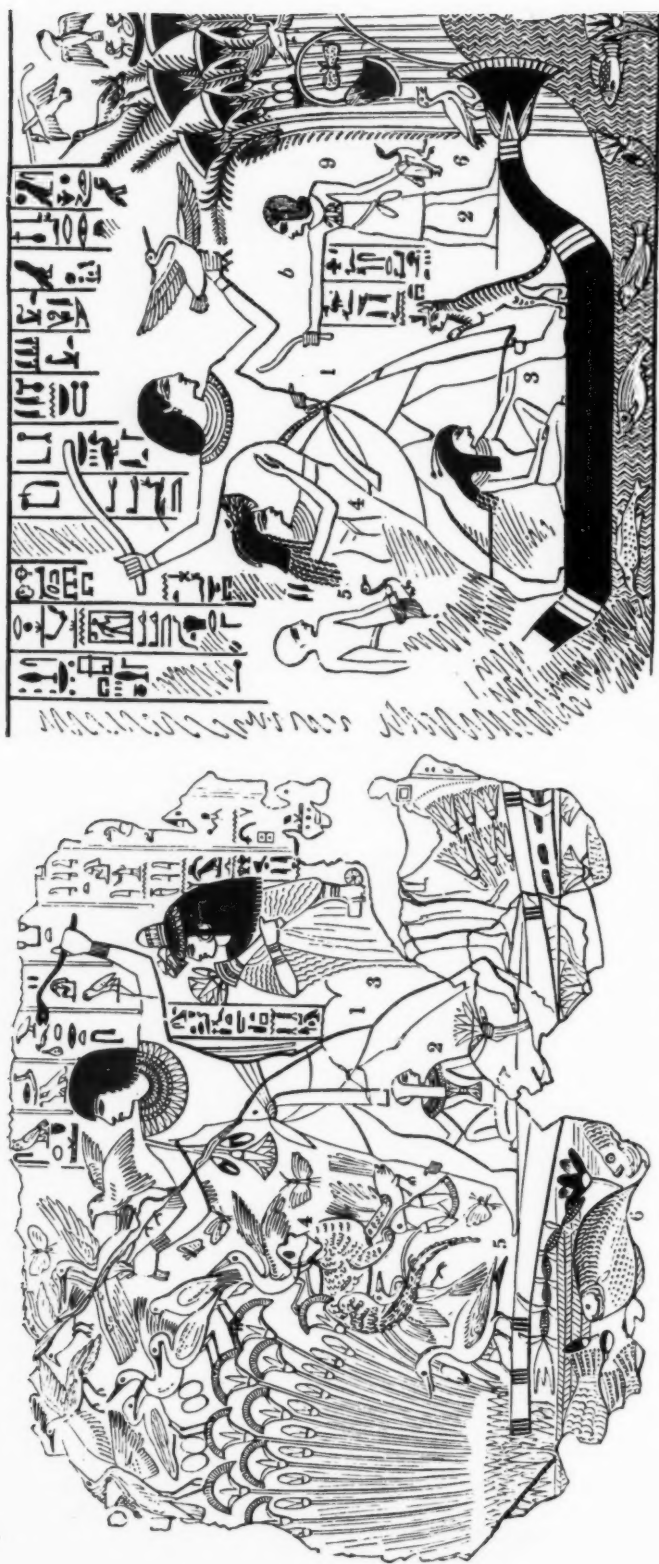
An inclination for fishing on the part

of an animal which normally shows a most marked antipathy to getting wet, would seem to be a reversion to primitive habits. That a similar habit existed in an earlier period of the world's history we have reliable information. On the Egyptian monuments and tombs are found representations of cats accompanying their masters on fowling expeditions and engaged in retrieving birds from the water. Such an activity today would be thought wonderful since the feline race in these later times seems almost entirely to have lost this ancestral faculty. However, we shall see that among cats both wild and tame retrieving still prevails in some cases and in certain countries. Indeed tame cats frequently bring back to their masters the rats, rabbits, birds, lizards, and even snakes which they have caught. Charles St. John in his delightful *Sketches of the Wild Sports and Natural History of the Highlands* (London, 1878, p. 47), tells of three cats, known to him, that hunted for game which they always brought home. But let us proceed at once to the more interesting accounts of fishing by cats.

I.

FISHING BY WILD CATS

The wild *Felidæ* certainly find their sustenance in part in crayfish, crabs, and fishes, denizens of the waters—not merely feeding on those cast up on the shore, but fishing for those actively swimming. This is probably an ancestral habit, as noted above, for, as will be shown later, it is practised today by certain wild cats (using the term in a wide generic sense) and is a



THE CAT AS A RETRIEVER OF WATER BIRDS

It would appear probable that the cat was occasionally employed in Ancient Egypt for retrieving. Although Sir I. Gardner Wilkinson, from whose *Manners and Customs of the Ancient Egyptians* the above illustrations are reproduced, voices doubt whether a cat "could be induced, on any consideration, to take the water in quest of a fallen bird," the number of instances, presented in this article, of cats, both domestic and wild, that brave the water in their pursuit of fish, gives assurance that the above pictures record real happenings.

In the illustration on the left the cat is depicted seizing a bird in a thicket of lotus, while its master, poised in the boat, is about to use his throw-stick upon another bird victim. In the picture on the right the cat is represented as though pleading to be let out of the boat into the thicket

habit reverted to, under suitable conditions and provocation, by our common house cats.

SOUTH AMERICAN WILD CATS

Practically all these cats feed on fish, as specific instances quoted below will show. Indeed, William Swainson (1838) says that the (South) American tiger cats are more aquatic than those of any other continent and that they live largely "upon the boundless profusion of fish which swarm in its numerous and majestic rivers." In particular he names the jaguar as an expert fisherman.

Azara in the Spanish edition of his book on the Paraguayan quadrupeds (1802) alleges that Marcgrave and Piso say that the South American jaguar prefers fish to flesh. This, if true, would be our oldest reference to wild Felidæ eating fish, but it is certainly erroneous. I have gone minutely through both the 1648 and the 1658 editions of their *Historia Naturalis Brasiliæ* and cannot find one word as to the food of the jaguar. I find, however, that Azara takes this statement from the volume on Quadrupeds of Buffon's *Histoire Naturelle*, and hence the latter is fundamentally responsible for the error. The oldest record, then, seems to be that in Azara's book (page 93), where he says, according to the English version (1838), that:

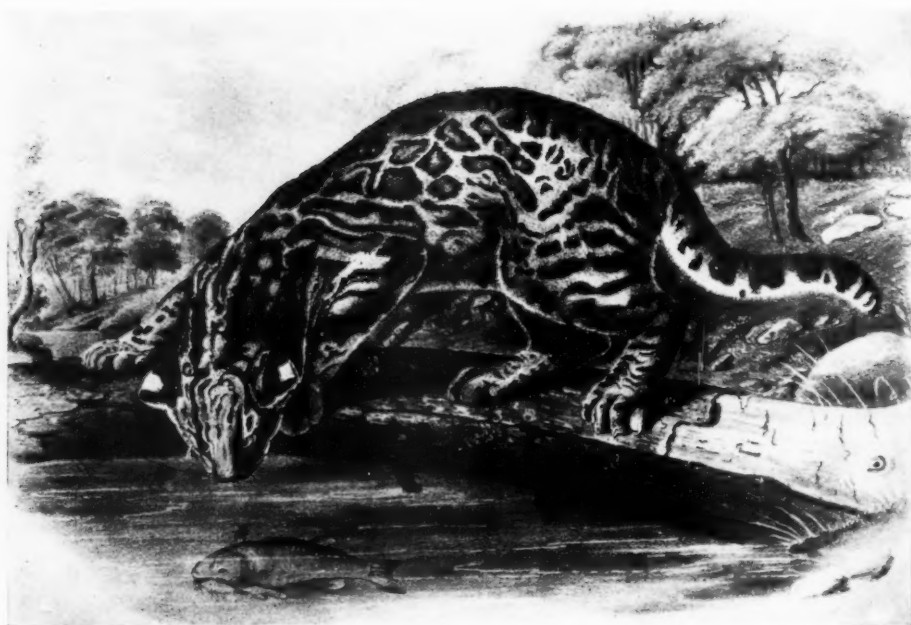
It is very generally asserted in these parts, that the jaguar frequently goes into the water a little way, and there discharges some saliva, which attracts the fish, which greedily snap at it, when the jaguar, who is very fond of them, by a stroke of his paw, tosses them on the bank. Various persons have assured me that they have seen them fishing in this way and have collected the fish which they have thrown out; for they do not devour them immediately, but wait until they have caught sufficient for a meal.

We are fortunate in having next an eye-witness account from Rengger (1830), a Swiss naturalist who spent eight years in Paraguay. He states that:

Regarding the manner in which the Jaguar provides himself with fish, many tales are told in Paraguay. For example, it is said that he is able to charm the fish by the froth of his saliva or by beating with his tail upon the surface of the water. A very intelligent huntsman, to whom I am indebted for many noteworthy observations and much good advice in my travels, gave me a better account, and my own observation proved to me later the veracity of his assertion. On the approach of a storm one sultry summer evening, as I was returning home in my boat, my companion, an Indian, noticed a Jaguar on the edge of the stream. We drew nearer and hid ourselves under the overhanging willow trees in order to observe his actions. He was sitting crouched on a projection of the shore, where the water was running rather more swiftly, the usual habitat of a preying fish, known in the country as Dorado. Unswervingly he directed his glance at the water, swaying forward from time to time as if he wished to gaze into the depths. After about a quarter of an hour I saw him make a sudden blow with his paw and throw a large fish on to the land. Thus he fishes in the same way as our domestic cat.

The next reference to the fishing proclivities of the jaguar is in La Cordière (1832), who tells us that the jaguars of Brazil and Guiana visit the seashore at night and from overhanging rocks reach down thorny paws and hurl out on land the fish and crabs, which they then eat at their leisure.

Roulin (1865) records an experience of a native boatman of his in 1824 on the upper Orinoco. A jaguar and her kittens had been seen at a small rapid, where the mother caught fishes ascending it. She distributed the fishes until the hunger of all was satisfied and then allowed the kittens to try their skill also at the fishing. This they did in most charming imitation of her.



The Decisive Moment.—The ocelot, on the verge of action, like a trigger about to be snapped, awaits the approach to the surface of the unsuspecting catfish. Reproduced from a picture by J. W. Audubon

Other and similar reports have emanated from travelers in South America, who, however, have gotten their accounts from the Indians. Very interesting is the incident related by that accurate observer, Herbert M. Smith (1879), in whose narrative we again note the use of the tail. Smith tells us:

The spotted Jaguar belongs here [on the rivers of Brazil] of right; he is a fisherman as well as a hunter, and, though he often wanders on the highland, you never find him far from water. The Indians have a curious story about his fishing. The Jaguar, they say, comes at night and crouches on a log or branch over the water; he raps the surface [of the water] with his tail, gently, and the *tambakis*, or other fruit-eating fish, come to the sound, when he knocks them out with his paw. I do not take it upon myself to say that this story is true, but I have heard it from all sides, and from persons who aver that they have seen the fishing.

R. Stewart Clough, writing of the habits of animals in the Amazon region, makes a similar comment regarding the jaguar, which, he says, "may often be seen engaged in piscatorial exercise, as he draws his tail backwards and forwards in the water until approached by his finny prey, when with lightning speed his sharp-clawed paw grasps the prize."

Caspar Whitney (1912), who has had wide experience in travel in South America, speaks several times in his book, *The Flowing Road*, of the jaguar's "scooping" fish out of the water with a swift forepaw, and says more in detail:

In the Río de la Plata, just off Buenos Aires, is an island where at one time several jaguars lived and thrived practically off the fish they caught. There was no other life on the island and never any evidence of the beasts visiting the mainland, which, so far as distance is concerned, was entirely possible, because the

tiger is a strong, bold swimmer, and minds no river of South America, not the widest, if he wishes to reach the opposite bank. He is a patient, unerring fisherman, watching for long periods from some vantage point, which may be either a fallen tree trunk extending into the stream, or at the bank's edge, until a victim draws within reach, when with a lightning blow he hurls the fish out on to the bank.

NORTH AMERICAN WILD CATS

First of all Audubon and Bachman (1851) in their delightful work on North American quadrupeds figure an ocelot crouching on a tree trunk extending over a pool, and eagerly watching a catfish in the clear water below. The cat is evidently waiting for the catfish to come further out where he can reach it. Unfortunately there is nothing in their text to explain the incident depicted in their figure, which is reproduced herewith.

Adams (1870) reports that settlers in New Brunswick, Canada, told him that many persons had watched the

Canada lynx and had seen it catch fishes in brooks in similar fashion. Elliott (1883) in his great monograph says that the bay lynx is not afraid of water but seeks the streams in quest of fish and frogs.

EUROPEAN AND INDIAN WILD CATS

The preceding accounts all allege that these great cats simply "scoop out" their prey with a rapid flashing paw, but J. Bowden (1869) asserts that the Norwegian wild cats dive readily into the water in pursuit of rats, and, since fishes are better food, presumably for them also. At any rate, they are said to "go in all over."

In another part of the world, however, there is a wild cat whose menu is made up to so large an extent of fish that he is called "the fishing cat." This is the *Felis viverrina* of India. The first account of it that I have been able to trace is in Mivart (1881), who quotes it from Buchanan, pre-



Although this cat (*Felis viverrina*) eats, it is said, other things besides fish, nevertheless fish form so large a part of its diet that it well merits the name "fishing cat." Reproduced from *The Cat* by St. George Mivart

sumably Francis Buchanan, afterwards Buchanan-Hamilton, author of *Fishes of the Ganges*. I have made a careful search through all the works of this writer, but have nowhere found any reference to the "fishing cat," whose portrait is herewith reproduced from Mivart. Statements similar to those of Mivart are made by all the other writers on the mammals of India; each repeats the other but not one gives his source. Probably all the statements are ultimately taken from Buchanan-Hamilton's manuscript notes.

It is presumably *Felis viverrina*, whose habitat extends into the Malay Peninsula, to which White (1912) refers in these words:

The fisherman cat is found here. We kept one for a time and studied its methods of plunging into the large tray of water and securing the live fish at a single pounce, with both forepaws, putting its head under the water and bringing it out in its mouth.

Furthermore, Simson (1886) in his charming account of hunting in eastern Bengal, tells us that the tigers on the islands in the lower Ganges and Brahmaputra, during times of inundation, when other food is scarce, eat fish, turtles, young crocodiles, and large lizards—in fact, anything on which they can get their paws. And it seems not improbable that they *catch* these fish, since they are not infrequently forced, through the flooding of the land, to take refuge in trees. Corroboration is the earlier record by Walter Elliott (1839), who was told by the Bheels of Kandaish that during the monsoons, when the country is flooded and food is scarce, tigers eagerly eat frogs.

II.

FISHING EXPLOITS OF THE HOUSE CAT

There is now to be presented a large mass of evidence relating to the fishing

proclivities of our common house cat, *Felis domestica*, for puss does not confine herself to "grabbling" for goldfish but really "goes a-fishing." These accounts readily fall into five groups: first, where Tabby or Tom merely accompanies the fisherman, hoping to share in the catch; secondly, where puss seeks a stream or pond by herself and catches fishes by the scooping-out process; thirdly, where the cat goes in "all over" to catch the prey that is in full retreat; fourthly, where she brings the fish home as the evidence of her prowess; and lastly, where she trains other cats in fishing.

However, before beginning our categorical account there is to be set forth a manner of fishing in which the cat does not even get its feet wet. Flying fish, disturbed by the motion of a vessel, will spring out of the water and, attracted by the lights on the vessel, will frequently come aboard if her bulwarks are not too high. In this connection Ross (1868) says that an officer on an Australian packet told him of a ship's cat that would watch for hours on a windy night, awaiting the flying fish that would thus come aboard.

Dr. Gordon Stables (1874), the well-known authority on domestic animals, gives a more detailed account and goes Ross one better by alleging that the cat himself supplies the attracting light—from his eyes! His lively recital reads thus:

On dark nights in the tropical seas, he [the cat] used to perch himself on the bulwarks aft, and bend his glittering eyes downwards into the sea. He never sat long thus without a flying fish, sometimes two, jumping past him or over him, and alighting on deck. Then Tom would descend and have a delightful supper, and if not fully satisfied [would] resume his seat and continue the sport. Tom must have gained his knowledge from experience, al-

though the success of his method of fishing is easily explained. It is well known that these fish always fly towards a light, which is therefore used by the sailors to catch them. The cat required no other light save the glimmering of his two eyes, which in the dark shone like a couple of Koh-i-noors.

CATS THAT ACCOMPANY FISHERMEN

Under the first category, wherein the cat merely goes along hoping to share the spoils, I am able to present a personal experience, for which I am indebted to Mrs. Paul Bucher, of the information division of the New York Public Library. Mrs. Bucher says:

In the years shortly after 1890, I and various members of my family used to go fishing in Kensico Reservoir. On one occasion, as we stopped at the keeper's house to engage a rowboat we were observed by the tiger-marked cat belonging to the keeper. Evidently the presence of fishing poles and bait cans aroused high hopes of fresh fish, for the cat scampered after us to the shore of the reservoir and jumped into our boat before we were seated. We were out on the water in the boat for several hours, with a fair catch of small fish such as perch and sunfish. During this time the cat seemed perfectly at home and very much interested in any movement of the fishing lines. When the fish were lifted from the water, she would hang over the gunwale with outstretched paw, in what frequently seemed a precarious state of balance. She received a number of the smaller fish as caught and made short work of devouring them. We learned later that she had been accustomed to following fishing parties for several years.

Stables gives the following interesting account of a tabby that "was a curious specimen of the feline fish catcher."

Her master was a disciple of Walton's. With eager and joyful looks, pussy used to watch him taking down the rod and fishing-basket, sit singing beside him while he looked to his tackle, and rub herself against his leg while he prepared the invariable sandwich, as much as to say 'Don't forget a morsel for your puss, she likewise is going a-fishing.' Then she would trot by his side all the way,

as proud as Punch, to the distant streamlet. Anxiously she would watch the skimming fly, squaring her lips and emitting little excited screams of delight, whenever a fish rose to nibble. Then, when a trout was landed, pussy at once threw herself upon it and despatched it.

A writer in *The Angler's Note Book* under the *nom de plume* of "March Brown" (1880) tells of an old fisherman on the Tweed known personally to him, who had a cat that always accompanied him when he went fly-fishing. This cat was evidently a good sportsman, for:

When . . . a fish was hooked . . . her eagerness could not be controlled, and so soon as the captive was in shoal water in sprang puss up to her shoulders, and fixing her claws firmly in the fish brought it to bank, when with a caress from Donald she again took her place behind him till another trout was on the line and the sport repeated.

In this connection the readers of *NATURAL HISTORY* will recall the accounts in my previous article, "Dogs as Fishermen," of canines which went a-fishing with their masters and in similar fashion would help bring the hooked fishes to land.

CATS THAT FISH FOR THEMSELVES

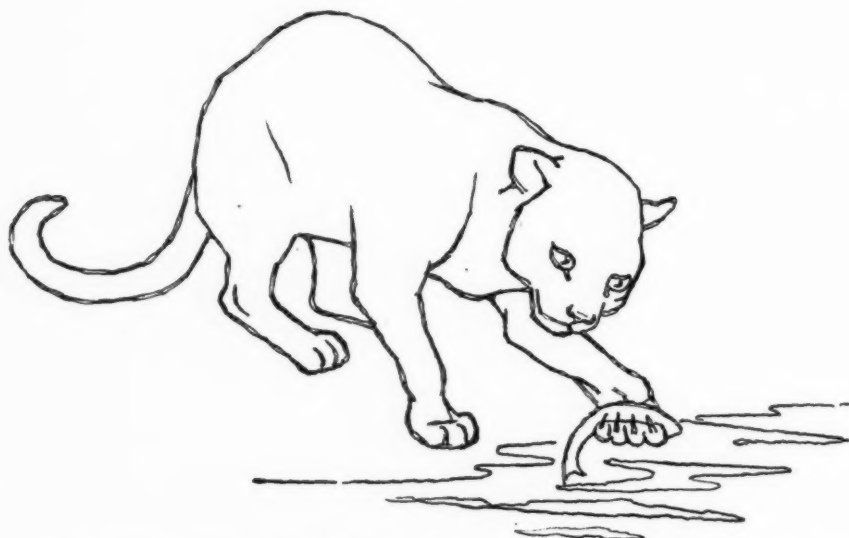
Before taking up, under our second category, the quoted accounts of cats which fish along the banks of streams, I fortunately can give a first-hand account related to me by Miss Annie Smith of Bronxville, New York, of cats fishing along the seashore. Miss Smith writes that:

About 1898 my father took his family in the late fall for a short visit to the seashore at Asbury Park, New Jersey. One frosty night in October, he came in and asked us to go down to the seashore for a most unusual sight, that all the cats in Asbury Park were gathered on the seashore a-fishing. When we reached the shore, we found quite a crowd gathered watching the cats fishing with very great luck.

It was a bright moonlight night, cold and very still. The ocean was rather calm and

each small wave that broke on the shore brought with it myriads of small fish—'white-bait'—chased inshore by larger fish. The former were very slender fish, white and silvery. They sparkled and flashed in the waves before these broke on the beach, and afterwards they were easily seen and pounced upon by the stray cats left homeless and hungry by the cottagers who had closed their summer homes and had returned to the city for the winter. The cats had no hesitation in wetting their feet, so intent were they on getting the fish.

White's *Natural History of Selborne* (1851). In Roxburghshire a fine cat lived near a mill. When grinding ceased and the water was cut off, the mill pond began to fill up, and the stream below, supplied now only by the leaks in the dam, ran shallow and left in difficulties the fishes which had come up during the flood. "And so well acquainted had puss become with this circumstance, and so fond was she



This drawing, supplied by Mr. E. H. Forbush, shows that the domestic cat does not confine its depredations to the goldfish bowl

For three successive nights the little fish appeared, driven inshore by their enemies, and each night the cats were there, to a Tom intent on their fishing, and the audience of the genus *Homo* was also there taking in this most unusual and interesting occurrence.

We now come to a number of accounts which merely recite the fact that cats following the course of a stream will hook out unwary fishes and eat them. These, lacking, in the main, points of particular interest, will be briefly considered.

The first of these incidents is from Jardine's footnotes in his edition of

of fish, that the moment the noise of the mill-clapper ceased, she used to scamper off to the dam, and, up to her belly in water, continued to catch fish like an otter." Two other accounts, very similar to this, are also given.

The next incident is from Adams (1870), who had it on good authority that in a household in County Cork, Ireland, there was a cat that regularly repaired to a brook, where it was frequently observed capturing small fish.

In the volume by Stables from which citation has been made, that author

recites a number of instances of cats that fished along the banks of streams and in shallows. The best of these accounts is of a cat that seriously diminished the number of salmon in the stream which he patronized.

Gibbey was a noted fisherman and a daring and reckless poacher, so much so that the gamekeepers threatened to kill him, whenever they could catch him. They did not mind, they said, his taking a good clean sea trout occasionally; but the beast fished in season and out of season. In fact, Gibbey found the spawning time much more convenient than any other. When the salmon came up the shallows to spawn in thousands, all wagging under his very nose, and to be had for the mere lifting out, he couldn't stand that. "Tam tint his reason a' thegither" and played terrible havoc among the poor fishes. It was not so much what he ate that the keepers grudged; but he was in the constant habit of carrying away large fish to hide for future use; and as he generally forgot where he had put them, he still went on hiding more.

Accounts are given by Wier (1889) of a cat that would take an eel out of a pail of water, and of others that would fish in shallow streams. And Lane (1903) tells of a cat that made her living almost entirely by catching fish along the banks of a near-by stream. It will be recalled in this connection that similar actions by dogs are recorded in my paper previously referred to.

Most interesting of all accounts of this kind is one related by "March Brown" from a personal experience, already alluded to. The cat of which he speaks, for a while threatened to spoil his fishing. His boatman had collected a large number of minnows for bait and had placed them in a "well," or enclosed spring of cold water, two or three feet deep. Things went along uneventfully for several days but presently the minnows began to disappear. The "well" was then watched one night and the mystery solved:

At the well-side stood puss, the favorite of the household; with arched back and extended paw she took her prey. When an unfortunate minnow approached the surface, sharp was the dash made by puss, arm and shoulder were boldly immersed, and straightway the victim lay gasping on the bank; fishing in this manner she soon captured half-a-dozen, and was then driven away; from that evening the well was always covered with a net, which scared puss into enforced honesty.

Mr. E. H. Forbush quotes in his valuable monograph (1916) the observations of several correspondents in Massachusetts who saw cats fishing for trout in streams that are low in summer or for smelts and eels in shallow tide pools along the seashore. He gives also a figure, reproduced herein, showing a cat "flipping" out a fish with a paw the claws of which are unsheathed for action.

I now have the pleasure of giving an unpublished observation which has come to me first-hand from the observer himself, Mr. Herbert Lang, associate curator of African mammals in the American Museum. The incidents related occurred at Öhringen, Württemberg, Germany, about 1889.

We boys often used to fish in a small lake behind our house. One evening a friend of mine discovered our old gray cat sitting on one of the many stones which emerged from the water where it was shallow. Watching her intently we saw her make a dash, and, sure enough, she had caught a fish. Later on, and for several years thereafter, two or three other cats came to fish, but only during the summer months and just before dusk. At this hour a great number of fish were playing about the stones among the green mosslike algæ. The cats always sat on their haunches bent somewhat toward the water, as immovable as if carved of stone. But suddenly a paw would shoot out and a fish be caught, to be taken into the mouth or landed on the stone. Though the cats sometimes missed their aim, it seldom took them more than twenty minutes to get their fill. Four fishes, each about two or three inches long, was the maxi-

mum we ever saw any one catch. Heads and tails were not consumed. When opportunity offered, the same cats would also steal much larger fishes out of pails. These they usually attacked in the neck region.

These incidents are all very well and really do not overstrain one's credulity, but will the cat, with a dread of water amounting to a veritable hydrophobia, leap into the water, swim, and dive for its prey? Are the accounts previously given final or do they lead up to a series of diving episodes? Let the following accounts be the answer.

DIVING CATS

The first incident to be given is related by John McDairmid (1830). The chief occupation of the cat mentioned therein was hunting in winter and fishing in summer:

Her custom was to dern [*sic*] herself by the side of a pool . . . and when a trout rose at the shallowest part of the water, she immediately sprung on it. . . . These exploits cost her many a ducking, but her patience was equal to this and more, and what with exercise and the frequent use of the cold bath she acquired all the hardihood of a wild cat, though she retained her docile habits when at home.

The next account in this category is from Scales (1831) and is both very interesting and very much to the point.

Many a time and oft have I watched puss . . . watching on the brink [of the fish-pond] for its finny inhabitants, and on their appearing at the surface darting on her prey, and in spite of the wetting and ducking she encountered, bringing them in triumph to the pond's edge, and regaling [herself] on the delicious fare. This sport, I believe, she continued in the enjoyment of till the day of her death. . . . The pond was . . . completely a cockney pond . . . therefore before puss could gratify her taste, a plunge was to be taken which was sufficient to make the stoutest cat's heart tremble.

In the same note is an account of another cat (known to Scales), which used to dive after water rats in a pond. This was the cat's constant practice for nine or ten years—till his death. As he never ate the rats, it is evident that his motive was pure sport.

The next account of a cat swimming and diving for fish is that by John Dixon (1854), who writes:

A friend of mine . . . tells me he well remembers a cat at Aberford Mills, that was a regular fisher in the little rivulet there, (the Cock). So soon as the wheels were stopped, and the mill race once again placed, puss might often have been seen, generally at noon, swimming and diving about in pursuit of her finny prey. It was not exactly "bobbing for eels," but "tickling trout," that was most to her fancy, and when these grew scarce, smaller fry in the shape of minnows, were made to suffice; "better sma' fish than nane."

Stables says that he has dozens of accounts of cats diving and fishing, and gives a few striking ones. These nearly all relate to millers' cats, which, he alleges, almost invariably take to the water in pursuit of prey. One interesting account reads as follows:

I know an instance of a cat bred and reared at a flour mill. It was a universal custom with this pussy to watch by the dam-side, where she might have been seen at any time either in winter or in summer. She used to run along the edge of the water in full tilt after a trout until it stopped; then, seeming to take aim for a few seconds, she would dive down like an arrow from a bow, and never failed to land the fish.

Of another cat at a mill in Aberdeenshire he relates that she was "an excellent swimmer and fisher, and as fond of the water as an Irish spaniel."

When fishing, she did not confine herself to any one portion of the stream, and whether deep or shallow it was all one to pussy. The boys, too, of the neighborhood, were not long in finding out, that, by whatever part of the rivulet they saw the miller's cat fishing, there they would find trout in greatest abundance.

Stables (1876) also tells of a certain cat that was fond of eels and always managed to provide for herself. Another cat, white in color, was one day seen walking along some distance away, with what was apparently a black band or necktie around her neck. On closer inspection it was found that the supposed band was an eel, the head of which was in her mouth. Of yet another feline he writes, "I have, myself, watched a cat by the banks of a stream until I have seen him dive into the water, and emerge almost immediately with a large trout in his mouth."

Lane (in the work previously cited) speaks of an old friend and neighbor of his, who in his youth lived in Dumfriesshire near the Annon River, in which he was accustomed to fish and bathe. He was generally accompanied by his cat, which was pure white, except for a black smudge covering the face, head, and ears. This marking gave the cat a most sinister appearance and led to his being called Beelzebub. On one occasion, when his master was bathing, Beelzebub sprang into the water, swam to him, climbed on his shoulder, and was thus borne ashore. Lane concludes:

Ever afterwards the cat was observed to visit the river on his own account, and swim after the small fry, driving them into shallow water, catching and making a meal of them, and never seemed troubled with the natural aversion generally felt by cats to water, but would plunge boldly in and swim about like a dog.

At this point I again have the pleasure of giving an unpublished first-hand observation, which was communicated to me by Miss Maurine Pickett of Little Rock, Arkansas. The incidents she relates took place in 1921 when she and her family were

living in Bloomingdale, Indiana. We shall let her give the account in her own words:

My small brother, Marion, was accustomed to fish in a little branch [brook] that ran through our pasture. One day he put a six-inch catfish and two smaller sunfish in a puddle about four inches deep, at the outlet of the milk trough from the dairy. Some time later he went back to look for his fishes, but they were not to be found. Tom, our cat, was sitting near by, washing his face and wearing the expression of having just "eaten the canary." Now Tom was an ordinary large white cat with green eyes and the usual fondness for mice and milk. But Marion suspected him and took steps immediately to prove his guilt. Accordingly he ran to the branch with line and bait. When he caught another fish, he brought it to the puddle and called Tom. Tom watched the fish intently for a few moments, then he thrust his paw into the water, caught the fish, and held it, just as he would a mouse, until he could get it in his mouth. He enjoyed this fish very much and did not seem to mind getting his face and paw wet.

Marion was delighted with the experiment. For several days he spent most of his time fishing for Tom and watching him catch the fishes out of the puddle.

As Tom's appetite for fish was cultivated, he learned to associate Marion's trips to the branch with pole and bait, with the fish in the puddle. When Marion would start to the branch, Tom would follow. The fishing "hole" was about eight feet across and was probably eighteen inches deep in the center. Tom saw that in this hole fish like those he had taken from the puddle were swimming about. He watched them for a few minutes, waiting for one of them to become quiet, then he dived about two feet out into the water, caught the fish with his paw, got it into his mouth, and swam back to the bank, reaching the same point that he had left. Every hair was dripping, but Tom didn't care. As soon as he had disposed of that fish, he caught another in the same manner.

The next day Tom went with Marion to the branch again. He caught his fish and swam like a veteran. After that it was not necessary to go fishing with Tom—Tom went by himself. He learned also how to catch frogs along the marshy places at the

edge of the branch. Almost every day for the rest of the summer we would see Tom coming from the branch with his fur all parted from being wet. This daily plunge kept his coat very white and clean. He was known in the neighborhood as the diving cat. We don't know whether he became too popular or what happened. At any rate, a few days before we left Indiana for Arkansas, Tom disappeared and we haven't heard of him since.

CATS THAT BRING BACK FISH TO THEIR MASTERS

In the article "Dogs as Fishermen," previously referred to, I have shown that in some parts of the world dogs act as aids to their masters by driving the fish into nets, and that some even bring their catch to their owners. Cats do not seem to enact the former rôle, but some, like dogs, have acted as purveyors for their masters. We shall now briefly consider some of these cases.

First of all, F. O. Morris (1860) tells of a cat that used to bring home eels and other fish caught in a pond near by. Charles H. Ross (1868) gives us two very concise accounts. He says that a Mr. Moody of Jesmond, near Newcastle upon Tyne, had in 1829 a remarkable fishing cat which he had owned for a number of years, and which "caught fish with great assiduity and frequently brought them home alive. Besides minnows and eels, she occasionally carried home pilchards, one of which, about 6 inches long, was once found in her possession."

Mr. Ross's second account is quoted from the *Plymouth Journal*, an English publication, of June, 1828, in which it is stated that:

There is now at the Battery, on Devil's Point, a cat, which is an expert catcher of the finny tribe, being in the constant habit of diving into the sea and bringing up the fish alive in her mouth, and depositing it in the guard room for the use of the sailors. She is now seven years old, and has long been a useful caterer. It is supposed that her pursuit of

the water-rats first taught her to venture into the water, to which it is well known Puss has a natural aversion. She is now as fond of the water as a Newfoundland dog, and takes her regular peregrinations along the rocks at its edge, looking out for her game, and ready to dive for it at a moment's notice.

Fennell (1874) records that a cottager in Wiltshire had a cat which would dive and catch trout, and these the cat would bring to her mistress as she would captured rats or mice. Furthermore, Stables, in the two works listed in the bibliography at the close of this article, reports this habit as being characteristic of a number of cats. One carried home an eel. In another case a fisherman lost a fine salmon through the breaking of his line. Next morning the fish with the hook in its mouth was found on the doorstep alongside the household cat.

Several of the authors cited (particularly Stables) note that cats that develop the fishing habit are mainly millers' cats. These cats, domiciled at mills to keep down the plague of mice and rats, catch water rats as well as house rats and presently develop the habit of going into the water after their prey. In this water they will find fish, their best-loved food. Suppose, then, that a cat in trying to catch a water rat makes a misplay and catches a fish—in this may not improbably be found the beginning of the habit of deliberate fishing.

CATS THAT TRAIN OTHER CATS

Furthermore, a cat thus self-trained may in turn train another cat. So relates Ross, in speaking of the cat previously referred to. ". . . she also contrived to teach a neighbor's cat to fish, and the two were sometimes seen together watching by the river side for their prey. At other times they were seen at opposite sides of the river, not

far from each other, on the lookout for game."

Stables makes the general statement that cats not only learn to swim and dive but teach their young to do so, and he avers that this interesting practice has been transmitted in certain families of cats even to the third and fourth generation. Here it may be recalled that in my previous article on "Dogs as Fishermen" it was recounted that a fishing dog was trained by being taken out with an older and trained dog, and that another dog trained her puppy so well that he became a better fisher than his parent.

Speaking specifically of a miller's cat which was an expert fisher,

Stables gives the following charming account:

This cat not only fished herself, but taught her children to do so. The way in which she managed this was very amusing, and shows how extremely sagacious feline nature is. When the kittens came of sufficient age she would entice them down some fine sunny day, to a part of the stream, where the water was very clear and shallow. Here the smaller trout-fry and minnows would be gambolling; and, making a spring, pussy would seize one of these and bring it out alive. After letting it jump about for some little time, to amuse the kittens and attract their undivided attention, she would kill and return it to the stream, jumping after it, and playing with it in the water to entice a kitten in. Thus, in course of time, the kittens could all swim and fish, and rivalled even their mother in quickness and daring.



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The Mimicry of Minerals

By HERBERT P. WHITLOCK

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BETWEEN the perfectly formed crystal developed to ideal proportions and free from distortion, and massive bodies which do not possess any outward token of crystallization, we find among minerals a wide range of examples of molecular architecture which are known as crystalline aggregates. Many of these mimic the forms of animate nature, producing fanciful shapes of great diversity and beauty.

Water, which is so common a substance that few of us realize that it is really a mineral, furnishes us with an admirable instance of the wealth of exquisite patterns produced by crystallization. Where water vapor is cooled slowly to just the point of freezing, its molecules are drawn together to form little flat six-sided crystals familiar to anyone who has looked closely at snowflakes. With somewhat more rapid cooling of the air the minute nucleus of the snow crystal becomes the center of intricate branching and starlike forms of wonderful symmetry. Where water vapor consolidates on a cold sheet of glass, for instance a windowpane, the water crystals grow much more rapidly, and interlacing patterns of rods—produced by one tiny crystal forming against another—or branching, fernlike forms result. Lastly, where dripping water is consolidated by the cold, the rounded shapes of icicles, resulting from the quick solidification of a liquid, give no outward evidence of the inward ordering of their molecules, although this arrangement is the same that has produced the snow crystal and the window frost.

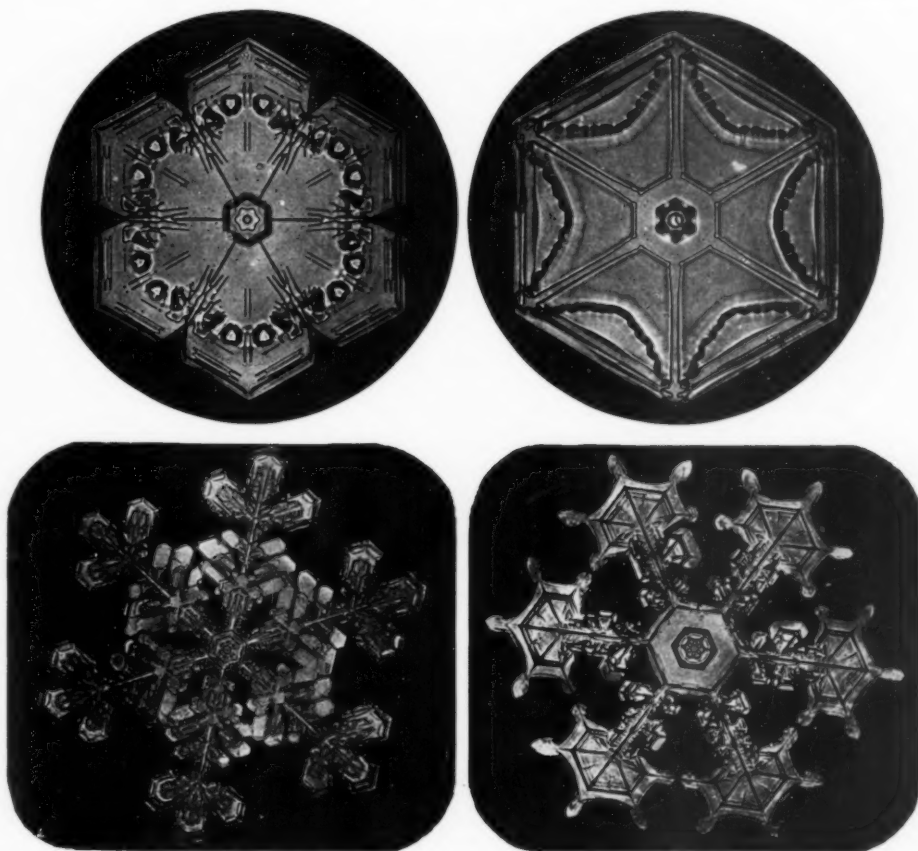
The knowledge how window frost is produced enables us to understand the meaning of the so-called *dendritic* structure, assumed by a number of minerals. Such minute and intimate crystal groupings as are to be seen in moss agate bear a very close resemblance to the delicate tracery of the vegetable world, and at first glance we are almost forced to the belief that they are in reality fossil plants. However, we have but to compare them with the frost designs that the touch of winter leaves upon our windowpane to realize their true nature.

Sometimes the long-drawn-out prisms of a mineral will group themselves in masses, suggesting a bundle of sticks or the slender fluted columns that distinguish some kinds of architecture. From the latter resemblance this kind of grouping has been called columnar structure. Or again the long thin rods, which are in reality prismatic crystals, interlace to form a netlike structure with angular open spaces. This kind of structure may be seen in some varieties of the minerals rutile and cerussite.

Crystals seem to have a tendency to attach themselves to a support by one of their extremities with the result that their greatest length is directed outward. A crystal of slender prismatic habit will usually project from the rock to which it is affixed in much the same way that an iron filing sticks out from the magnet that attracts it, and if the crystal happens to be flat and platelike, it will very often be found fastened by its edge. Needle-like

or hairlike crystals attached to a projecting point will tend to radiate from this point as a center and will assume a structure like a tuft of hairs.

more perfect as the radiating prisms that form it are more thickly grouped. An excellent instance of the perfect roundness assumed by these "mineral



The tiny six-sided plate (upper row) which, under conditions of slow crystallization, is typical of snow, with a somewhat more rapid cooling of the air becomes the center of intricate, branching, and starlike forms of wonderful symmetry (lower row)

A number of minerals furnish examples of this grouping. Perhaps the most striking illustration is to be found in the radiating crystal aggregates of the mineral natrolite, which from a center thrust out their glistening white needles sometimes an inch and a half or more in all directions. As it usually happens that the length of these needle-like prisms is fairly constant, the outer surface of the group assumes the shape of a ball, the outline of which becomes

"balls" is found in the mineral wavellite, which takes on forms that remind us of the familiar fluffy seed balls of the dandelion. Occasionally the radiating structure has for its nucleus a single small fragment of a mineral, such as a fragment of quartz or a minute crystal, and the conditions are such that crystals are freely developed in all directions around this center. In this way the concretionary balls of the mineral pyrite are produced in slate,



Crystalline Aggregate of the Mineral Pyrolusite (Manganese Dioxide).—This structure, which is called dendritic, is formed in the same way as window frost, which it closely resembles

and when these are cut in sections through the centers, they constitute the beautiful and remarkable objects that are known as pyrite "sunbursts."

The mineral hematite often crystallizes in flat hexagonal plates. Some-

times these platelike crystals attach themselves to a projecting point in overlapping piles in much the same manner that the petals of a rose are fastened to its calyx. The fanciful name of "iron roses" has been given to



NATROLITE

Long slender silky needles of the mineral natrolite radiating from a central nucleus suggest a fluffy seed ball of the dandelion. Wavellite is another mineral that assumes forms of this type



The flat platelike crystals of hematite sometimes bunch themselves in forms resembling the petals of a rose

these groupings. When the plates are more thickly packed together, a variety of curious and interesting crystal structures result, such as the crested aggregates of the mineral barite and the sheaflike bundles of the mineral stilbite. The flat crystals of calamine, a silicate of zinc, tend to group themselves in rounded ridges, notched at the crest where the angular edges of the crystals emerge from the group. From a fancied resemblance to the notched comb of a rooster, this grouping has been called "cockscorn" structure.

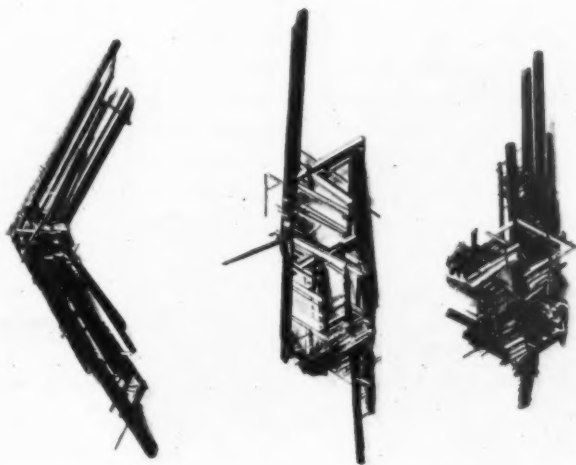
Frequently among minerals the crystal individuals are so crowded together that no single crystal has a chance to develop its regular and characteristic

outline, or to assume with its neighbors a distinctive group or aggregate. Such a structure, made up of packed-together crystal units, may resemble, when broken, a lump of sugar or a mass of common table salt made solid by moisture. Because they are made up of masses of coarse or fine grains, we call such structures massive and characterize them as "coarse granular" or "fine granular," each of the "grains" being a tiny crystal lacking the outward form it would have had if it had been permitted a free and unobstructed growth.

We have touched upon some of the more significant examples of crystal structure and have endeavored to ex-

plain how nature operating through the inflexible laws of crystallization has out of inorganic matter fashioned the intricate shapes which often suggest the forms of life. We have opened the door to this fascinating maze of form and color only a little way, and have permitted merely a glimpse at the wonders within. To draw a comparison from the animate world, the relation between crystalline aggregates and

the individual crystals that compose them is outwardly much the same as the relation between a compound flower and the separate florets that make up its intricate form. And just as in the realm of plants we find countless shapes among compound flowers, so in the mineral kingdom the varied forms assumed by groups of crystals continually excite our wonder and admiration.



Long thin crystals of rutile (titanium dioxide), which group themselves in masses, suggesting the slender columns characteristic of certain types of architecture

Eclipses

AS INTERPRETED BY THE AMERICAN ABORIGINES

By HERBERT F. SCHWARZ

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WHEN New Yorkers poured out of their homes in the early morning of January 24 and hastened to the upper sections of the city and to the suburbs to await the eclipse, they were confident to a man that they could rely on the predictions of the astronomer. Watch in hand, they knew that the celestial mechanism, more dependable than the contrivances run by man, would perform its predestined functions on the scheduled minute.

Contrast with this mental preparedness, the utter unexpectedness of such a phenomenon among savage peoples. Without any warning, the orb of day, the source of their light and warmth and cheer, is invaded by a dark monster that nibbles its way deeper and deeper into the heart of the sun, which shrinks before the assault. At length the

sinister antagonist has overpowered it, obliterated it; and only a ghostly radiance remains of the blazing majesty that previously no man dared look upon. Nor is the sense of awe and bewilderment much less when there is a similar obscuration of the moon.

Again and again among primitive peoples the devouring monster is given a definite designation. The Indians of the Cape Flattery region of Washington, who, it is said, have named many of the constellations after such creatures of the sea as the whale, halibut, skate, and shark, further reflect their maritime culture in their explanation of eclipses, which they look upon as the attempts of a fish like the "cultus" cod, or *toosh-kow*, to eat the sun or moon. The moon, they say, is made of a jelly-like substance such as fish enjoy—a morsel presumably as palatable as the green cheese moon of nursery tale days. According to Cherokee myth it is a great frog up in the sky that tries now and then to swallow the sun or the moon. And these people add "Everybody knows this, even the Creeks and the other tribes." Apparently, however, the Creeks have another explanation for the celestial phenomenon, for according to Daniel G. Brinton these Indians were wont to thrash their dogs during an eclipse and, when they were asked for an explanation of their behavior, they replied that "The big dog was swallowing the sun, and that by whipping the little ones they could make him desist." Certain of the Caribs of the West Indian region attributed eclipses to their devil, Maboia, who seeks the destruction of the sun and the moon.



Analysis of Mexican Record, showing occurrences of the year Two Reed, 1507: The figure marked (2) represents an eclipse of the sun, and (3) an earthquake. Reproduced from *Ancient Civilizations of Mexico* by Herbert J. Spinden, to which the reader is referred for an explanation of the other figures

To drive off the spirit of evil that threatens the light of the world unenlightened man relies on noise. Even in seventeenth century England we come upon this quaint bit of advice: "Imitate not the wild Irish or Welch, who, during eclipses, run about beating kettles and pans, thinking their clamour and vexations available to the assistance of the higher orbs." Throughout aboriginal America similar methods of combating the foe in the heavens were widely employed. James Adair, writing of an eclipse that occurred in 1736 while he was sojourning among the Cherokee, says that "During the continuance of it, their conduct appeared very surprising to one who had not seen the like before; they all ran wild, this way and that way, like lunatics, firing their guns, whooping and hallooing, beating of kettles, ringing horse-bells, and making the most horrid noises that human beings possibly could." Sometimes even firearms were employed to drive off the celestial aggressor.

Although indiscriminate noise—the louder, the better—was usually deemed effective, there is an interesting instance to the contrary reported by Joseph Gumilla, a Spanish missionary who visited the tribes along the Orinoco in the first half of the eighteenth century. During a lunar eclipse, he tells us, the married men of the Otomacs, snatch up their arms, rush about, yell discordantly, fit their arrows to their bows as a sign of indignation, and in turn command and entreat the moon not to die. But when in spite of all their efforts, its light becomes less and less, and they come to realize that the moon is deaf to their appeal, they rush to their homes and upbraid their women folk for not exerting themselves in bewailing the infirmity of the moon.

The women, however, give no evidence that they grasp what their husbands are saying and do not answer so much as a word. The men, seeing they can accomplish nothing by force, change their tone and begin to supplicate their women to weep and wail so that the moon may recover. The entreaties of the men are all in vain. Thereupon they proceed to the distribution of gifts, which conquers all resistance on the part of the women. The men part with their gaudy ornaments; each gives the best he has,—some beads of glass, others necklaces of monkeys' teeth, and similar finery dear to the feminine heart. Then the women go out to salute the moon and in mournful tones address supplications to it; and as this function takes place at the time when the moon is about to recover its light, a little while after they have urged their request, the luminary is again whole and clear. Then the Otomacs heap thanks upon their women, whose lamentation, according to their notion, moved the moon to compassion and persuaded it not to die.

This conception of the moon as ill and threatened with impending death has its counterpart in other regions. Among the Tewa of the upper Rio Grande Valley, for instance, when there is an eclipse, the luminary is referred to as dying.

Another interesting instance reported by Gumilla from the Orinoco region is to the effect that the Indians at times of eclipse seize their agricultural implements and begin vigorously cultivating their fields under the impression that the moon is showing its anger because of their lazy ways. "But," adds the Padre, "as soon as the moon has recovered its light, they return to their houses . . . and think no more of sowing or of cultivating the soil. . . ."



The solar eclipse of August 7, 1869, as recorded by Lone Dog, a Dakota chief, on his buffalo robe. The sun is painted black, the stars red. From "Picture-Writing of the American Indians" by Garrick Mallory

Allusion has been made to the belief that eclipses are caused by some monster of the sky bent on the destruction of the sun or the moon, or again that the waning light of the luminary affected is due to its infirmity and approaching death, or finally that the bright disk is withdrawing in anger, refusing to shine for an offending people. There remains yet another common conception, namely, that sun and moon are hostile to each other and that an eclipse is the time when they come to blows. Thus the Arawaks among whom E. F. im Thurn sojournd, shouted and yelled in order to separate the celestial combatants as they grappled with each other.

Reference may be made at this point to a myth, widespread among the Eskimo.¹ It is the belief of this people that moon and sun are respectively brother and sister who parted in anger. According to Franz Boas, who reports the legend from Cumberland Bay, it is the brother who is pursuing his sister through the heavens, and this is the prevalent conception and the one depicted in the mural of the Northwest Indian hall, American Museum. The tale, however, has its variants and, as reported by Lucien M. Turner from the Ungava District, Hudson Bay Territory, it is the sister who, armed with a brand from the fire, pursues the brother, the sparks streaming from her torch becoming the stars. Turner adds that, when an eclipse occurs, sun and moon are supposed to meet.

¹This myth and its variants are very widespread. They are found from the Pacific Northwest to Greenland. A close analogue occurs among the Cherokee. A variant, but with all the essential features preserved, has been reported from British Guiana.

A myth, obtained by Walter E. Roth at first-hand from the Pomeroun Arawaks, explains a lunar eclipse as due to the moon's falling asleep in the path of the sun and being overtaken before it can get out of the way. To warn the slumbering moon of the approach of the sun these Indians make the usual din. Furthermore, they abstain from taking food under the impression that those who eat at such times are changed into the animal or plant of which they partake.

The belief in a pursuit of one celestial body by the other was not confined to the New World. Citation may be made in this connection of an eclipse myth as recorded by William T. Olcott in *Sun Lore of All Ages*.

The primitive natives of the Malay Peninsula . . . regarded the Sun and Moon as women and the stars as the Moon's children. A legend relates that the Sun had as many children as the Moon, in ancient times, and fearing that mankind could not bear so much brightness and heat, the Sun and Moon agreed to devour their children.

The Moon pretended to thus dispose of hers and hid them instead; but the Sun kept faith, and made way with all her children. When they were all devoured, the Moon brought hers out from their hiding-place. When the Sun saw them she was very angry, and pursued the Moon to kill her, and the chase is a perpetual one. Sometimes the Sun comes near enough to bite the Moon, and then men say there is an eclipse.

Just as in the Old World a battle in the war between the Medes and the Lydians was stopped, according to Herodotus, by a solar eclipse, so in the New, tradition tells us, a war between the Mohawks and the Senecas was averted through the timely obscuration of the sun. The alleged event is associated with the eclipse of June 28, 1451.

Whatever doubt there may be as to the authenticity of this pre-Columbian happening, it is certain that, in the

Western Hemisphere as in the Eastern, eclipses had their part in shaping the course of history. With the exception of the conspiracy of Pontiac, there was perhaps no concerted effort of the Indians that was better planned and organized, or calculated to present a more formidable obstacle to the encroachment of the whites, than the movement headed by Tecumtha. Yet that movement, dependent upon the coöperation and unity of purpose of many tribes, probably could not have made such headway if the interest of the Indians in the preservation of their native life and ways from the corrupting influence of the foreign race had not been kindled to fever heat by the fanatical zeal of Tecumtha's brother, the shaman Tenskwatawa, who exercised an extraordinary influence not only over his people, the Shawano, but even over relatively remote tribes. Yet his hold upon the savages had not been established without opposition and in the beginning the Miami and even the chiefs of his own tribe looked askance at his growing prestige. At this time of wavering, when perhaps the course of events might still have been turned, he effectually silenced all opposition by proving to the satisfaction of doubters and scoffers that he was a man inspired. He had learned that an eclipse of the sun was to take place in the summer of 1806 and, as the time approached, he boldly asserted that on a designated day he would prove his spiritual power by blackening the face of the sun. When at mid-day the eclipse occurred, the frightened redmen one and all proclaimed him a true prophet.

The shaman Smohalla, one of the most extraordinary characters the red race has produced, gained a reputation as a prophet through consulting an

almanac in which the occurrence of different eclipses was forecast. He failed, however, to reckon with the circumstance that the dates of these celestial events are not constant from year to year, and after the expiration of the period covered by the almanac, his astronomical predictions came to an inglorious end.¹

Yet in taking advantage of the credulity of his tribe, the Indian medicine man was but following the example set by the discoverer of America. In the gloomy days of February, 1504, when Columbus, deserted by many of his mutinous followers, lay ill in Jamaica, and the Indians, incensed by the inhuman treatment from which they had suffered, refused to be cajoled or threatened into delivering food, the Admiral thought out a way of gaining mastery over the savages. He knew that on the twenty-ninth of the month would occur an eclipse of the moon. Summoning the chiefs a day before the event, he announced to them that God was angry because of their failure to assist the Spaniards, that He was about to punish them with famine and other calamities, and as a sign of His intention He would give them a warning not to be mistaken, nothing less than the obliteration of the moon as it sailed through the sky.

When the eclipse came to pass as predicted, Columbus withdrew but, returning just before the emergence of the moon, announced that he had interceded with the Deity on behalf of the Indians and that God, being magnanimous, had determined to forgive them. When thereupon the moon struggled out of the shadow and little by little regained its splendor, the victory of Columbus was complete.

¹The Ghost-Dance Religion and the Sioux Outbreak of 1890," by James Mooney. Fourteenth Annual Report, Bureau of Ethnology.

The Value of Palæontology

By W. D. MATTHEW

Curator of Vertebrate Palæontology, American Museum

A FEW men, a mere handful scattered among the millions of civilization, devote their lives to collecting and studying fossils. A larger number take a more casual interest in the results of these studies. The vast majority have never heard of fossils or ask indifferently, "Why should anyone waste his time upon such useless studies?"

This is the answer:

In the first place, what are fossils? They are the teeth or bones or shells of animals found buried in the solid rock. Centuries ago these were noticed by ancient writers, who wondered how they got there. Some thought that they were creatures half-formed and left unfinished when the creative day was ended. Others thought that they were a mere *lusus naturæ*. But in time everybody had to admit that they were remains of real animals which had been buried in the rock when it was soft sand or mud and preserved, sometimes very perfectly, when it hardened into rock. Then it was discovered that many of these fossil remains were of animals more or less unlike any that exist today. It was found, moreover, and has since been confirmed by such overwhelming proofs that none save the veriest ignoramus would venture to challenge the statement, that each formation had its own peculiar kinds of fossils, different from those in the overlying rock strata and from those that lay beneath, as well as unlike anything that now exists. One could recognize a certain formation wherever it showed up at the surface

of the earth by the fossils that it contained. Here was a very practical use for palæontology. It was a great aid, oftentimes indispensable, to the geologist in identifying and mapping the successive geological formations. With its aid he could trace the probable extension and depth beneath the surface of the formations containing coal or oil or other useful minerals, and the great mining industries of our modern civilization depend largely upon this sure foundation for their success and vast expansion.

But there is another aspect of palæontology which adds not to our wealth but to our knowledge of the world we live in. These fossils, remains of animals that have lived in past ages but no longer survive, are the records of the history of life. We collect and study and compare them so that we can reconstruct these extinct animals, so that we can find out, as far as may be, just how they differed from those that preceded and from those that succeeded them, how they lived and to what environment they were adapted. Our aim is to reconstruct the history of life during the vast periods of time that have elapsed since the first rocks were formed.

Current history is but a passing phase, a stage in the march of events, past, present, and future. We cannot follow present events without becoming keenly interested in the past, which explains the present, and in the future, which we can predict more certainly if we have an adequate knowledge of the past and the present.

The more we know of these, the more clearly can we discern the laws that govern the orderly progress of events, the more definitely and positively can we perceive what is to come, at least in its broader outlines. Herein lies the great fascination of historical studies: in the attempt to synthesize and arrange the infinite multiplicity of events great and small, to find the underlying causes to whose interaction they may be ascribed, to test and prove the soundness of our theories by bringing them to bear upon other groups of events, above all to apply the acid test of fulfilment of our prophecies, the confirmation of our theories by new discoveries and forthcoming events. To read the future is the dearest wish of man and it can be done in so far as his knowledge and understanding of the past show whence we have come and whither we are going.

But history in the ordinary sense of the word deals with but a limited portion of the past of man. The world in which we live has a far wider scope and its history extends backward through enormous periods of time in comparison with the few thousands of years covered by recorded human history. In these dark ages of prehistoric time vast and complex movements and changes have gone on, whose final results we see emerging from obscurity into the bright light of history. From the study of these results we can infer a great deal as to the causes that brought them about, but aside from this indirect evidence we know of the history of life only what we can learn from the rocks and the fossils preserved therein, which constitute our records of the prehistoric ages.

From these fossil records, the "documents" of earth history, it has been possible to build up a great and splen-

did science, secure and fixed in its massive foundations and its broader lines of structure, more doubtful and speculative in some of its lighter tracery and ornamentation. Those who, through field work and study, have been able to add brick by brick to extend and amplify its solid basis, who have learned the laws of its architecture and aided in building up its superstructure, who have at times been privileged to add some bright pinnacle or favorite cornice to its glittering towers—these men have come to love their science beyond all else. It is their home which they have helped to build, and its beauty and symmetry, its noble and appropriate proportions, and its perfection of detail fill them with an ever-growing admiration and affection.

Do you wonder that the palæontologist, absorbed in contemplation of his splendid edifice, walks a little apart from the ways of men; that the little personal affairs and interests of the fleeting present which make up the world of his fellows, seem to him but gewgaws and trifles of no importance? His field of vision embraces the whole of life. His time scale is so gigantic that it dwarfs to insignificance the centuries of human endeavor. And the laws and principles which he studies are those which control the whole great stream of life, upon which the happenings of our daily existence appear but as little surface ripples.

Preëminent among the laws which govern the architecture of our world of life is evolution. To the zoölogist the law of evolution appears as a theory, an explanation of the world of nature that lies about him. It is the only theory that really explains it, and it fits all the marvelously complex details of adaptation, the perfections and likewise the imperfections of structure

of every animal and plant so perfectly and accurately that few or no zoölogists can question the theory, however they may dispute about the precise method of its action.

To the palæontologist, however, evolution appears not as a theory but as a fact of record. He does not and cannot doubt the gradual development of diversely specialized races from a common ancestral stock through a long series of intermediate gradations, for he has before him all these stages in the evolution of the race preserved as fossils, each in its appropriate place in the successive strata of a geologic period. It is not a matter of deduction but of observation, at least in those races of animals whose fossil record has been discovered; for the rest it is a matter of obvious inference. Concerning the causes and methods of this evolutionary process he finds wide room for discussion; but of the fact, of the actuality of it, he can have no doubt. Evolution is no more a theory to the man who has collected and studied fossils than the city of New York is a theory to the man who lives in it.

But, in truth, evolution is only one aspect of the order of nature, of the relations of cause and effect, of continuity of space and time, which pervade the universe and enable us to comprehend its simplicity of plan, its complexity of detail. The palæontologist, engaged in adding year by year to the mass of documents which record the history of life, in deciphering their meaning and interpreting their

significance, has no more occasion to doubt its continuity and orderly development than the historian has to doubt the continuity and consecutive evolution of human history, or the student of current affairs to doubt that the events of today will result in the conditions of tomorrow.

We have much to learn concerning the details of these great natural laws, their mode of operation, the manner in which the changing environment has influenced the course of development of all living beings, and of the nature of life itself. But of all this there is no more solid and direct evidence than that furnished by the records of the past which are found in the rocks, provided we keep ever in mind their necessary incompleteness and the comparatively slight and oftentimes superficial examination and study of them that has thus far been possible.

Such is the value of palæontology. It provides an essential part of the evidence for scientific study of the rocks, which has made possible the huge expansion of the mining industries upon which our modern material civilization is so largely based. Its higher value lies in adding to our knowledge and aiding in our comprehension of the world we live in, in tracing the past history of life and finding in it the explanation of the present, in observing the ordered progress of evolution under natural law from the beginnings of the world down to the present day, in helping us to discern through a better knowledge of the past what may be the course of future events.

The Marmots of Hannegan Pass

By WILLIAM T. SHAW

Professor of Zoology, State College of Washington

THIS morning, as I was coming down the trail from Hannegan Pass¹ over the alternate patches of slide rock and snow, my attention was sharply attracted by a furry object moving in an odd sort of way, on an old grass-grown moraine below. My first thought was of some trapped animal writhing in the agony of the grip of steel. On closer examination, the object proved to be two young marmots in a friendly bout. They were very deliberate and grotesque in this brotherly contest, very bearlike in their manner of attack. It was a playful sort of private affair; with the rest of the family complacently holding aloof at the front door across a log.

What a shot!

My camera was always eagerly operated in response to such an invitation, and while it was being rigged, I became aware of the shrill whistle of a marmot up the north slope of the pass, yet did not get the significance of the situation nor realize my opportunity until everything was ready and I began more carefully to study the surroundings. Soon a marmot was seen progressing down one of the rock slides, marmot fashion. She was not at ease but was evidently suspicious as she made her way toward me though still three hundred yards away. As she approached, it became evident that she must be the mother of this little brood, for only a mother would take such a risk.

If I was to make good use of my opportunity, I must keep her from

home, for once there, the young family would be under her direction if not direct command, so I acted accordingly. On she came by stages, flourishing her tail occasionally as these marmots were wont to do, and finally stopped beside a den in the midst of some yellow flowers, *Mimulus* I think they were. She was not still long, but roamed restlessly, and once or twice left some fine footprints in a near-at-hand snow bank. Gaining confidence, she came on and soon cantered over to a boulder under which was a hole, as was the case beneath most of the rocks of size, which seem to serve equally for sunning, lookout, and retreat. Thinking she might make a dash for the home den, I went over to frighten her away. Down went the old mother marmot under the big sheltering rock, only to reappear as soon as my back was turned. I had looked back and seen a young marmot viewing the situation from his front door, complacently ignoring my camera, which was carefully focused at the rear of his back porch. The mother showed much concern and appeared so persistently at the entrance of her retreat that I decided to focus on her, with one leg of the tripod within a very short distance of the hole which she occupied. I had not long to wait. In a few moments, from my place of vantage behind some red heather, I saw her clearly, squarely in the focus area, ready at a moment's notice to dart back into concealment. Feeling sure she had done her part and was likely to hold her pose, I pressed the release bulb firmly and forcefully and could

¹A pass in the northern Cascade Mountains of Washington, between the headwaters of the Nooksack and the Chilliwack; elevation, 4962 feet.



Photograph by William T. Shaw

The mother marmot, photographed as she cautiously surveyed the landscape, ready at the first suspicious sign to dart back to safety

hear the shutter register clearly and distinctly while there was not a tremor of the animal. What an exposure!

Once more I returned to the family residence and focused again on the back door, which was the choice from the standpoints of lighting and composition. And now began a prolonged wait. The little fellows appeared at long intervals, their bodies like round fluffy balls, their faces sooty but gray-nosed, with bright little shiny black eyes and orphan-like, droopy-cornered mouths. But they came up singly, therefore would not make companionable groupings, and something better might be had by waiting.

I had begun my vigil at eleven in the morning. Not until four o'clock did the marmots appear for the evening

pasture. First one ventured forth, then another; but always at the front door. Finally the sun had swung into the camera so I reset the apparatus, this time shooting down so as to obtain a comprehensive view of the front door, now in the shadow, with the earthen dooryard still nicely flooded with afternoon sunshine. One little fellow, the big brother of the family, came out, surveyed the country, and lounged over with such an air of characteristic abandonment that I could not resist the temptation to release the shutter for one lone figure (see p. 171). Next two,—and then to my astonishment five fair little woolly heads looked about over the great amphitheater of their mountain birthplace. It was all new to them, perhaps their first or

second day out from the great warm nest below. This time they saw me and, young as they were, darted in unison at the noise of the shutter. I had grave fears for the result!

Once more the mother came close and presently whistled a long shrill whistle, which sent the little ones pell-mell into the den.

Just to the right of Hannegan Pass, looking west, is a knob, behind which the sun now began to settle, throwing an ever-quickly-lengthening shadow over the flower-carpeted cirque, and soon the spot on which I was focusing was merged into the shade of the mountain. But I continued to lie there, watching the little family of marmots, which had reappeared, as they nibbled their first meal of grass. Earnestly they worked at it, slowly nipping, or squirrel-like holding bits

of vegetation in their paws, or rising bearlike on their hind feet as they ate.

Out over the meadow the mother was similarly engaged, for the quiet of evening was drawing on. In anticipation of coming night she gathered a great mouthful of dry vegetation from the ground and carried it roughly grasped to the den,—not neatly tucked in her mouth as is the case with ground squirrels and chipmunks when building nests. Evidently she meant to repair this wayside den for the night.

At six o'clock I left them, but at seven, from the distance, I could see them still cropping grass. In the evening light, they looked like little gray-backed bears with intensely sooty faces and breasts.

Next morning they were still about the den, the mother with them but, as I set out to visit them again, I saw her



Photograph by William T. Shaw

The temptation to release the shutter for one lone figure was irresistible

once more leave on one of her wanderings of wide range. Perhaps she was heading for the hill slope of succulent grass by the banks of snow.

Ascending one of the many great cañons of the Cascade Mountains, one comes to the thinning out of the forest, and here is the home of the hoary marmot. On the steep-sided, snow-patched, fir-walled sides of these cañons one sees fan-shaped banks winding down in ever-increasing talus slopes from the summit. Far distant, they appear gray and earthen; the binoculars reveal them as granular; a contact view shows them as they are: sloping masses of liberated, disintegrating, crumbling slabs of granite or basalt, augmented from time to time by shattered slabs that in their turn have broken from the faces of the cliff wall. Here and there a living tree springs from their desolation; a dead tree, moldering, has strewn its brown decay over their jagged surface; and everywhere about their base and sides is the greenest verdure of grass and blossoming shrub and stately forest tree. Everywhere, passages lead to a

forbidden mysterious inner region, a safe retreat for many a little mountain mammal. These "slides" of desolation have their life. The marmot in all his stately dignity stalks bearlike or canters lumberingly from rock slab to jagged point or flattens out luxuriantly in the sun on one of his high outstanding sentinel rocks, asleep to all appearances except for two wonderful black eyes, ever keenly watchful of the cañon side. His is the hoary majesty of the mountain rock slide!

Although the marmots love these stony fortresses for certain good reasons, finding shelter in them from bears and bobcats, they have resorted in many places to the grassy bottoms of the slides and, tunneling into the hidden crevices of an old flower-covered moraine, have established a colonial home.

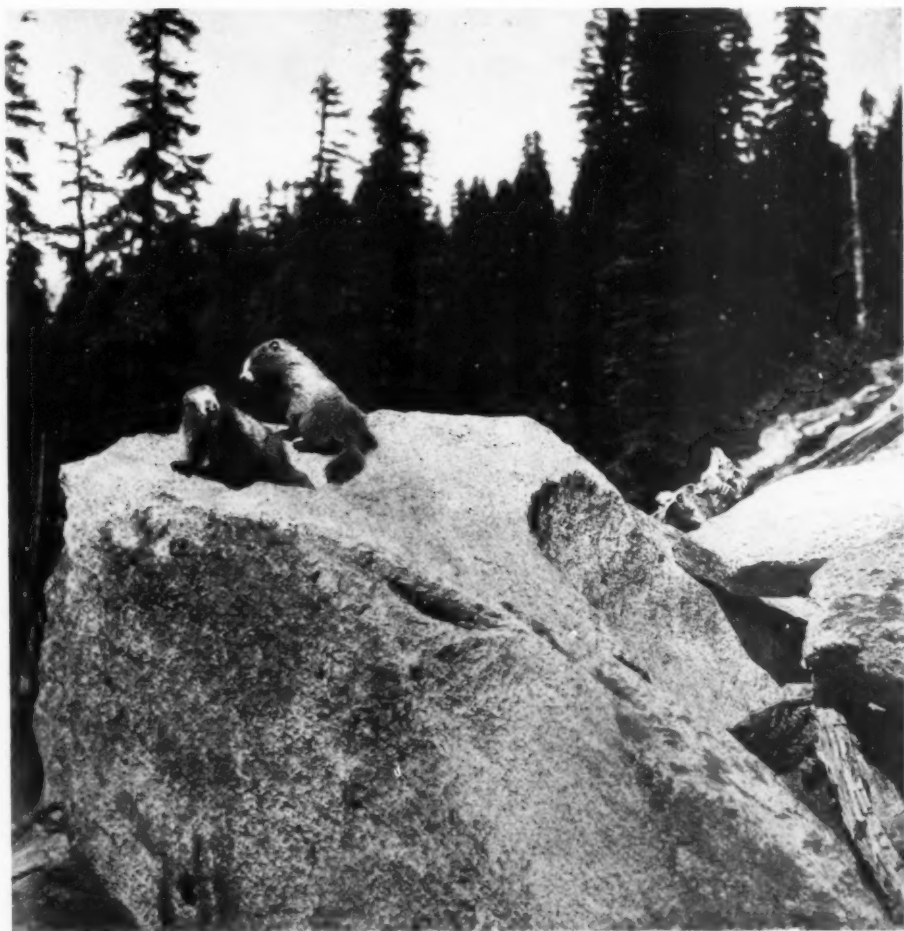
The animal known as the marmot, woodchuck, or ground hog, is widely distributed over temperate America, though represented by different species or kinds. The Cascade hoary marmot (*Marmota caligata cascadenensis*), is an alpine merging into an Arctic form. Few mammals among those inhabiting elevations from four thousand feet to the limit of vegetation, are more noteworthy. It is a great ponderous rodent, much larger and heavier than a common cat, differentiated from others of its group by having a very light region of fur on the back, especially over the shoulders. Occasionally individuals are found in a characteristic dark phase; sometimes such animals are almost black (see picture herewith). Probably more than any other mountain mammal, the hoary marmot dominates its particular landscape.

Riding into one of the headwater cirques of some mountain stream the horseman is met by a long-drawn whis-



Photograph by William T. Shaw

A marmot standing erect like a pygmy bear. This dark phase was found on the headwaters of the Suiattle River on Glacier Peak, Washington



Photograph by William T. Shaw

Idling away time on a sunny boulder

tle, very human in its sound and weird in its effect. Presently this call is answered by another, perhaps nearer or again more remote. Soon the landscape becomes populated with marmots, standing erect like pygmy bears among the flowers about their den or lying upon some rock on the hillside. They never tire, lazily watching a passing pack train or any new unusual sight. Perhaps, if their surroundings were less congenial, they would not spend so much time in this way,—but what is time to a marmot! They dearly love the sunlight and will sprawl for

many lazy hours, flat, ruglike, on the warm face of a slab in the rock slide, frequently not changing their indolent position even if others in the colony are giving the call of danger.

Like most terrestrial rodents of similar nature they are ever watchful of the enemy. No rock slide but has some great boulder higher than another; few burrow entrances but have mounds of earth lifting above the grass. Should an eagle suddenly swing around the shoulder of a cliff, instantly a sun-basking sentinel from his point of vantage whistles with



Photograph by William T. Shaw

PUYALLUP HEAD, MOUNT RAINIER, WASHINGTON
Here the eagle and the wild mountain goat are at home.



Photograph by William T. Shaw

LYMAN LAKE AND GLACIER, WASHINGTON

The foreground is typical of the home of the Cascade hoary marmot

piercing intensity and from innumerable lookout rocks and mounds mammal forms appear watchful and alert.

The hoary marmot is a hibernating mammal, appearing late or early in the spring according to altitude and amounts of neighboring snow. At Reflection Lake, Mount Rainier, on July 16, one year, an old female marmot was observed on a rock slide and with her was a litter of young, apparently just fresh from the den. She seemed very uneasy at sight of a passing stranger and, finding one of the youngsters which had wandered too far from home, deliberately picked it up with her teeth and carried it as a great Saint Bernard would a basket. The little creature was apparently held by one hind foot, and swung from side to side as the mother came cautiously down over the rocks.

The feeding range of the marmot is the neighboring wild grass-grown flower garden. The animal is quite truly diurnal.

On the broad grassy slopes of extensive mountain-sides are often found colonies of hoary marmots. On these green inclines great mounds occur, here and there. From below they look like sod-bound banks of earth; from above like a rostrum or platform, and to some extent they serve the same purpose. These rostra are many yards apart, and often the dens are connected by paths of sufficient width to afford a trail for the human foot. So nearly free are these paths from the slippery huckleberry stems that they afford relief from the ever-present strain of uncertain footing on the dewy mountain slope.

The course of these paths is often influenced by the boulders which lie scattered through the vegetation. It does not follow a straight line from

one den, or it may be one hole, to another, but zigzags through the heather and huckleberries so as to include as way stations the near-by rocks. A boulder only a few inches high gives the marmots the advantage of a view above the plant growth, and assures them of the peace of the mountain-side or warns them of impending danger.

Few sounds of the mountain glen are more memory-abiding than the wonderful air-piercing whistle of the hoary marmots, animals so aptly called whistling Jacks by the sheep men. *Cheer, cheer*, comes the call from the distance, faintly carried from far down the crag side. A mighty ice crag breaks, groaning, roaring, thundering; and we are reminded of the instability of a mountain moment. Tense wind, storm-pressed, plays strange music through the bony skeletal fingers of the bleached ghost trees long since fire-swept. But it is the shrill staccato cry of the whistling Jack that stirs up a thousand memories, every one eternally tied to wild, weird, high-mountain scenes.

Yet, is the voice of this splendid mountain mammal for itself alone? Surely a hundred little creatures must give heed to its warning and scamper to friendly shelter, indulging in bright-eyed peeps from many a shelving rock.

Once, on the headwaters of the Saint Andrews, we were lying at noonday among the slab rocks of a granite slide, viewing with the binoculars the white form of a goat on an opposite cañon wall. At the moment two great eagles drifted through the pass from the Puyallup head (see p. 174). Instantly it seemed all the marmots in Saint Andrews shrilled their piercing whistle of alarm. Whether or not *Oreamnes* took this warning for himself we do

not know, but he at once resumed his cliff-face journey.

Once again in the cañon of Hindoo Creek by the shadow of Mount Aix, I heard this wonderful call given as if for the entire cañon side. Most of the summer day had been spent beside a great lookout rock of a "slide," waiting for a wary old marmot. From time to time he or perhaps some of his race would send up from the cavernous depths beneath, a series of piercing, hysterically uttered calls, as if to tell me that my presence was quite well known though not at all appreciated. *Cheer, cheer, cheer*, in a running succession at first; then the call would die down in frequency and volume, and finally cease. Here and there a cony, the little haymaker of the mountains, would take his rock-tip station and speak to me inquiringly. Then a more venturesome one would slip out into meadows bordering the rock slide and bring in a bundle of freshly snapped hay. A chipmunk would appear here, a rock squirrel there, until presently

the quiet scene was animated with little rodent forms. From the cañon side, far-distant, lone sentinels still gave their desultory calls. Suddenly! So suddenly that I still stood wide-eyed when it was over and past, a great swift shadow shot over the slide with the swish of a falling pine, but in the thrilling action of that ill-planned moment the whistler sentinel had seen and heard, and from that instant the cañon from crag to crag fairly crackled as with an electrical charge, high-pitched and piercing,—above, below, wherever a shaggy marmot stood; and in that moment of shadow and shrieking cry, the rock slide became as deserted as if swept by death. Completing the rocket-like plunge of that powerful, wing-driven bolt from the crag crest, an eagle struck in the blueberries and heather,—a moment too late! Safe, under the sheltering rocks of that cañon side, was a very frightened little "haymaker," a very much frightened little "haymaker," that was all,—thanks to the warning of the big hoary marmot.





Mishongnovi, one of the villages where the *Majau* ritual was performed in September, 1916

A Women's Ceremony among the Hopi*

By ROBERT H. LOWIE

Associate Professor of Anthropology, University of California

AMONG the Hopi Indians of Arizona, the women play a less conspicuous part in native ritualism than do their brothers and husbands, nevertheless certain elaborate ceremonies are conducted very largely, though not entirely, by female members of what might be called religious organizations. One of these societies, the *Mámajauhtō*, performs the *Majau* rite, the public portion of which I was able to witness in September, 1916. Fairly detailed notes regarding the entire ceremony as practised at the village of Walpi¹ have been published by Dr. J. Walter Fewkes and Mr. A. M. Stephen, while the variant celebrated at the pueblo of Oraibi has been treated at length by Mr. H. R. Voth.² Though my own

observations were purely casual and limited to the proceedings of a single day, they were made in another village, Mishongnovi, and accordingly, meager as they are, have a supplementary value.

The *Majau* is a festival of nine days' duration, the major part of which period is spent in an underground chamber, where an elaborate altar is constructed by the priesthood and prayer offerings are made. These prayer offerings are deposited in springs and other sacred spots. At Oraibi the ceremony was specially associated with the Lizard clan,—that is, the chief functionaries, both male and female, belonged to that group. In Walpi, where the ritual has been discontinued, owing to the leader's conversion to Christianity, the former head priestess was of the Snake clan, which is regarded by the Hopi as somehow related

¹"The Mam-zrau'-ti: a Tusayan Ceremony." *American Anthropologist*, O. S., Vol. V, 1892, pp. 217-45.

²"The Oraibi Marau Ceremony." *Anthropological Series*, Field Museum, Vol. XI, No. 1, 1912.

*Photographs by the author

to the Lizard division. In that village, however, according to Fewkes, some of the male participants belonged to other clans, such as the Mustard and Water-house (Cloud) clans. At Mishongnovi I learned that Cucuñqiwa of the Chicken-hawk clan was the principal male performer, being designated as *Majau'-muñwi*, *Majau* chief. Unfortunately I have no record of the affiliations of the woman leader; in the neighboring village of Shipaulövi she is of the *Qälö* (Sun's Forehead) clan.

In 1916 the members first entered their kiva (or subterranean ceremonial chamber) on September 15, but in accordance with traditional usage not this day but the one following was reckoned as the initial day of the *Majau*. I was told that they were using the kiva ordinarily associated with a men's fraternity called the *Wöwötcim*: in token of their occupancy an emblem of feathers was put on the

roof of the chamber. For several days preceding the final dance the men of the village went on a rabbit hunt. It is not certain that these trips had a ritualistic significance, but it was said that the hunting on September 21 was connected with the ceremony. On the evening of September 19, I was subsequently informed, the women of the society danced in the plaza for a short time, but as I was unfortunately not forewarned, I was not present.

On the 23d the final public solemnity was celebrated. A line of about twenty women and girls left the kiva and proceeded in single file to the Mishongnovi plaza. Some were old, others hardly more than two or three years of age. While some were clad in blankets of native make, others wore garments bought at the trader's store. The members, one and all, were carrying in each hand a wooden slab tipped with a wisp of grass. Proceeding to the center



Interior of kiva.—On the wall may be seen the Hopi symbolic design representing rain clouds and descending rain

of the square they formed a ring and intoned a low song, at the same time rhythmically moving their slabs up and down. These objects, which are called *majau'-vaho*, are decorated with symbolic designs, some of them representing clouds and rain, others corncobs, and so on. After a while the dancers, who hitherto had merely swayed their

The last woman to leave the kiva differed from the rest in being dressed in masculine apparel. She was differentiated also by the fact that she carried on her back a painted wooden board with a bow and arrows above it. My informant told me that this woman had been chosen for her special office on the preceding night. Instead



Walking in single file from the kiva to the plaza, the performers enter for the celebration of the dance, on the morning of the ninth day

bodies rhythmically without moving from their position, began slowly to move in a counter-clockwise direction.

While this performance was going on, practically the entire population of the village formed an attentive audience, some individuals being seated on a stone bench that extended along one side of the plaza, others with loosened hair standing up, while the residue enjoyed the spectacle from the box seats supplied by the terraces of their dwellings.

of facing the center of the ring with the other dancers, this dignitary was inclined toward them at an angle of about ninety degrees and danced backward as they moved counter-clockwise. She wore moccasins and low leggings, a large part of her legs below as well as above the knee remaining exposed, as were her forearms and part of her upper arms. Her shirt was a woven single-piece garment. A veil of horsehair hung down over her forehead, shielding



In the center of the plaza the dancers form a ring and intone a song, at the same time rhythmically moving their wooden slabs up and down



A pair of women, selected earlier in the day, make their appearance dressed as warriors



A woman archer discharging an arrow into space



Women warriors carrying food to be tossed among the spectators

her eyes and most of her nose. During the dance she held a foxskin in her hands.

Suddenly a pair of women, selected earlier in the day, made their appearance. They, too, were clad in male apparel. They were carrying bunches of *qohpi* grass, which they threw on the ground and shot at with bow and arrows. Their archery precipitated loud laughter on the part of the male spectators, for the women were not expert marksmen. Breaking through the circle of dancers, the archers, after depositing their weapons, disappeared from the square but soon returned with two big pottery bowls containing sweet-corn meal, with which they sat down within the circle. These officers wore strange feathered headdresses towering high into the air. At Oraibi Mr. Voth saw another pair of functionaries, namely, two lancers, whose duty it was to throw wheels before them and in turn to hurl long sticks at the wheels; but no such performers appeared at Mishongnovi.

A short time before the conclusion of the ceremony the archers approached, bearing basketry trays filled with peaches. The fruit they threw into the air, and as it descended, the bystanders scrambled to seize it. Then the archers walked away, while the

dance continued for several minutes after their departure. Finally all the dancers passed out of the plaza in single file, led by the shield bearer, and the ceremony was at an end.

Although even the ample accounts of Mr. Voth and of Doctor Fewkes and Mr. Stephen leave the *Majau* performance unexplained in many respects, this much is clear, that it represents, like so many other Hopi ceremonies, a rain ritual connected with the horticultural life of the natives. Thus, one of the deities invoked during the subterranean rites is *Mū-yiñg-wuh*, the germ god; and the shooting performance witnessed by myself symbolizes the lightning striking the corn-field, "an event which is regarded as the acme of fertilization" according to Fewkes and Stephen. The ornamentation of the painted slabs held by the dancers points to the same conclusion. But though the rain ritual undoubtedly constitutes the essence of the ceremony from the priesthood's point of view, we must not forget that the spectacular public rites serve the very genuine need for excitement and theatrical entertainment felt by the populace at large, that, in other words, such solemnities gratify the æsthetic as well as the religious cravings of the Hopi.





A two-headed copperhead (*Agkistrodon mokasen*) obtained by Eagle Scout Irvine H. Marshall in the woods near Coraopolis, Pennsylvania. Enlarged nearly three times



Courtesy of Dr. H. G. Williams

An X-ray of the copperhead, showing the structure of the dual head form

Two-headed Snakes

A NOT UNCOMMON PHENOMENON OF THE REPTILE WORLD

By B. T. B. HYDE

Educational Director, Kanohwahke Scout Camps, Palisades Interstate Park

ACCOUNTS of the occurrence of an extra or abnormal double part in various animals have appeared from time to time, but X-rays of that curious but not altogether rare anomaly, a two-headed snake, have seldom been published. The X-ray on the opposing page, made under the direction of Dr. H. G. Williams, of the College of Physicians and Surgeons, for the purpose of studying the skeletal structure, clearly reveals the dual head form, in which the basal plates are joined. The subject was one of twenty-eight unborn copperheads (*Agkistrodon mokasen*) removed from the dead mother by Eagle Scout Irvine H. Marshall, of Coraopolis, Pennsylvania, who had come upon her in the course of a hike through the woods.

Commenting upon the phenomenon, Prof. J. E. Guthrie, of Iowa State College, in a recent letter to the writer, states:

"It is interesting to know that the copperhead seems to contribute more than its share of double-headed specimens, if one may judge from records made."

Professor Guthrie goes on to say that there are only two instances of double-headedness in snakes that have come under his personal observation: the one a bull-snake embryo, the other a plains garter embryo (*Thamnophis radix*). Of the latter he says:

"Evidently the specimen of *Thamnophis radix* is much like the two-headed copperhead of which you speak, in the amount of doubleness, for the head

plates seem to be joined. Some twenty or thirty years ago I remember to have seen an early book of travels in America, but I do not recall the author's name. This man was a geographer and student of natural history, and he wrote about all he saw as did most of those early travelers. He mentions the finding of a double-headed snake of which evidently he did not know the species, and he raises question whether it represents merely an abnormality or whether possibly it is a new species, characterized by two heads. The volume in which the account appears is one of the old-fashioned leather-covered type and must have been issued well over one hundred years ago. I wish I could give you the specific reference but I have no way of knowing now who the writer was."

The instance in question could unfortunately not be traced but other clues contained in an unquoted portion of Professor Guthrie's letter enabled the writer to come upon additional references.

In an article entitled "Notes on the Reproduction of Certain Reptiles" contributed to the *American Naturalist* for April, 1903, Mr. C. S. Brimley tells of eggs of the black snake (*Coluber constrictor*) which came under his observation. One lot "contained among others, one egg which, though entirely normal in external appearance, was very abnormal internally, inasmuch as it contained two embryos, and one of these was a two-headed monster."

A recent letter received by the



Photograph by Elwin R. Sanborn, New York Zoological Society

A TWO-HEADED MILK SNAKE FROM THE BRONX

Unusual interest attaches to this abnormal specimen of *Lampropeltis triangulum* in that it was kept alive for several months in the reptile house of the New York Zoological Park. To feed it, a card had to be placed between the two heads, so that one of them might be restrained from seizing a morsel intended for the other

writer from Mr. Kenneth Lawrence, of Cranberry Lake, New York, may be quoted in this connection:

"On June 8, 1918, Mr. C. H. Eells and I were in the hay field raking up hay, when we discovered a very large female garter snake. We both started after her, and as soon as we caught up with her, the battle was on. When we had killed her, we threw her over a stump. A short distance away we discovered several little ones; there were thirteen, and the thirteenth was a two-headed snake."

An interesting instance is that reported by Mr. Ditmars, curator of reptiles in the New York Zoological Park. This was a two-headed milk snake (*Lampropeltis triangulum*), kept alive for several months in the reptile house in the Park, and photographed by Mr. Elwin R. Sanborn, the staff photographer. As the photograph indicates, the heads were in this case quite separate, each having about two inches of neck. To quote Mr. Ditmars:

"This abnormal creature was picked up as it was about to cross Jerome Avenue in the Bronx. It must have lived on the slope which led to the heights above. This same district also produced a half-grown albino milk snake. Most extraordinary indeed was it to find such a creature in the heart of a great city and unmolested for so long a time; earth worms and larvae of beetles were probably its food. In captivity, however, its principal food consisted of recently-born mice; and undoubtedly the creature would have lived to a normal age if it had not become infested with mites.

At times the heads would intertwine and wrestle with each other, and again the snake would move forward with the usual gliding motion, the tongues in action. This specimen was apparently about a year and a half old, probably born in August of one year, living through that year, and captured the following June. The snake grew more rapidly than usual, apparently due to the fact that each head seemed always hungry. In order that there might not be a congestion where the esophagi joined, one head was fed at a time, a card being placed between the heads so that one would not know the other was having a satisfying meal; otherwise each brain decided it wanted the morsel and the food was rent asunder."

Mr. Ditmars has had in captivity several young snakes with a dual head structure,—two of them rattlesnakes. In one of these instances the basal plates were joined, one head functioning with eyes and tongue, the other head having the mouth sealed and no tongue visible; in the other instance the two tongues were active and there were well-formed eyes in each head. Mr. Ditmars obtained two-headed creatures also from hatching hog-nosed snakes (*Heterodon contortrix*) and king snakes (*Lampropeltis getulus*).

Many other instances of two-headed snakes might be cited from the published literature regarding this phenomenon, but in this brief article it may suffice to say in conclusion that the recorded instances range from the barest indication of double-headedness to almost complete separation of the two constituent parts.

The Training of a Hawk

INCIDENTS OF A PERSONAL EXPERIENCE

By FRANK B. LEVY

A FEW years ago, while engaged in the pleasant pastime of watching a pair of breeding duck hawks, I became imbued with the idea of training one of the young birds in falconry. One thing led to another and before long I found myself immersed in the literature of the subject, both ancient and modern, with the result that I found the training of hawks was not insurmountably difficult and, at least for a bird lover, one of the most fascinating of diversions. I say fascinating, because it enables us to keep these noble birds in a condition that very closely approaches the wild state, and at the same time absolutely docile and willing to do our bidding. The sheer beauty of the birds, either on the hand or in the air, is in itself an adequate reward for the trouble of training them.

FALCONRY IN OLDEN TIMES

Falconry appears to have originated in the East, and to have been practiced there from time immemorial. At the present day, too, its stronghold is in the East,—China, India, and other parts of Asia.

Although on the Continent and in England falconry was practiced before the time of the crusades, yet it received its main impetus apparently in that era, when returning crusaders brought eastern falconers and their hawks back with them. This, at least, is the generally accepted statement, although the equipment of the western falconers departs from the original eastern pattern, and the methods used by the English trainers seem in some ways quite different from those of the

East. The slow development of centuries probably paved the way for the perfected art that blossomed forth about the thirteenth century. From that time on, falconry was pursued in the British Isles perhaps more keenly than any other sport ever has been. All classes took part in it. Hawks were allotted by rank: while prince and duke admired their falcon for her noble pitch and lordly stoop, the burgher and yeoman made good use of their goshawks, highborn ladies used the merlin, and even the serf and villein were not forgotten, being graciously allotted the useless kestrel. Only members of the royal family could legally use gyrfalcons, which were at that time the most highly prized of birds, enormous sums being spent for the best of them. Stringent laws were passed to protect the sport, and death was the penalty for molesting the falcon of a lord, or even the nest or young of wild hawks.

Of course we cannot help smiling at all this mediæval class regulation, but beneath it there must have been a very real appreciation of nature. Recently I have heard of an oölogist in Massachusetts who has collected in the last few years about 180 clutches of duck hawk eggs. I only wish that in this age there were some way to stop him; at least, if by chance any collector of such eggs reads this article, it is to be hoped that he may come to realize that the living bird is a thing more worthy of preservation than the eggshell emptied of its contents.

But to return to the olden days in England! The variety of quarry flown was remarkable: bustards, herons,

cranes, kites, geese, ducks, grouse, and partridges, all were taken with the peregrine and gyr, besides a host of lesser things. Many of the flights were very elaborate and covered great distances, notably that at the heron and the kite. Game hawking always was a favorite sport; it usually consisted of letting the falcon soar high in the air—"six steeples high" as they very prettily called it—and then putting the quarry up with beaters and dogs. "Hawking at the brook," or the taking of wild ducks in this manner, was probably the most common form of falconry; the jumping duck was usually cut down dead by the terrific stoop of the waiting falcon.

This sort of sport kept up even after the introduction of firearms; in Shakespeare's day, for instance, both hawk and gun were used. However, people gradually discovered that the new weapons could kill a great many more birds than hawks ever had destroyed, and the Civil War in the seventeenth century brought about such an upheaval that falconry in England died almost at one blow, and the Revolution in France had the same effect there. That is not to say that hawking actually became extinct; even subsequent to the Civil War it was practiced in England and Scotland although with none of its former pomp and splendor. It has retired into comparative quiet in clubs and private establishments, but even today peregrines are flown on Salisbury Plain, merlins on the Downs, and grouse and partridges still fall before the blow of the stooping game hawk.

HAWKS SUITABLE FOR FALCONRY

The hawks that lend themselves to falconry are divided structurally into two large groups: first, the falcons,

or long-winged, dark-eyed hawks, and secondly, the short-winged hawks, including the sparrow hawks and the goshawks. The falcons always have been regarded as the nobler group, and they certainly are much easier to handle and work with than their more lowly-bred, short-winged cousins.

In this country we have many falcons, the most noteworthy being the duck hawk (*Falco peregrinus anatum*), which was, and still is, perhaps the best bird that has ever been trained, being thought of by some even more highly than the gyrfalcon. We also have the pigeon hawk, the counterpart of the highly reputed European merlin, a bird that has tremendous dash and speed and that, like the merlin, should be trained in eight days.

Our short-winged hawks excel those of the Old World. We have the sharp-shinned and the goshawk, which are very similar to the Old World sparrow hawk and goshawk, but in addition there is our Cooper's hawk, a bird that possesses all the physical attributes of the sparrow hawk, and is besides large enough for almost any reasonable quarry.

PSYCHOLOGY OF HAWKS

In order to train a hawk you must know just what he will do under any given conditions and, therefore, to some extent, what he is thinking about. The difficulty is that no two hawks are at all alike; they vary individually in character even more than they do in plumage. I have had two birds from the same nest that were as different as could be: one was the best- and the other the worst-natured bird that I have ever seen. The birds will vary in every respect,—strength, size, feeding characteristics, courage, and amiability; and for that reason no man can specify



Photograph by Frank B. Levy

A trained tiercel weathering on the block

the correct treatment for any hawk without first becoming familiar with his pupil.

There are, however, certain characteristics common to all good hawks, and these I will dwell on briefly. In the first place, they are intelligent creatures; they can be fooled easily, of course, but that is rather a help than a drawback to the trainer. Once

convinced of your good intentions, they learn with astonishing rapidity any lesson that is diligently and skillfully taught them. I have trained a tiercel¹ to come to the lure in six lessons. And when they have learned a lesson, they are not apt to forget it; it seems to become a part of their nature.

¹The male is called a tiercel, usually applied to the peregrine.

It is well to remember, too, that they think of only one thing at a time,—when hungry, of food, and, when alarmed, only of that which has frightened them. Thus, to make them do your bidding, it is necessary only to have them think of the right thing at the proper time. The sight of the lure or a remembered sound will suggest food and, if hungry at that time, they will forget everything else, even the fact that they are flying free in the wind. A hawk newly trained may have been trying to get free all day but, if flown at the proper time in the proper way, he will forget that he is unrestrained, and will come to the lure from far across the countryside.

That gentleness is an attribute of the falcon may seem an astounding statement, but I can vouch for its truth. Duck hawks have been described as "the most bloody of our Raptores," but I beg to differ with this statement. Of course it must be remembered that individuals vary enormously, but I have seen wild duck hawks fly through flocks of pigeons without touching one: they certainly are not bloodthirsty creatures. I can state positively that trained hawks show only gentleness toward human beings, and the tiercel that I trained last summer did not once try to harm me after the second day; I used to carry him on my bare hand with complete confidence. Relentless and ruthless as he may be in his aerial pursuits, the duck hawk, when properly handled, makes the most gentle of pets, showing marked affection toward those he knows, and never missing an opportunity to take the coveted perch on the master's glove.

TRAINING

The reader will be wondering by this time just how the birds are trained.

Let us suppose that we have a captive duck hawk,—a rare phenomenon, to be sure, in this country where they are



Courtesy of Mr. MacNeil

Our noble bird in the position in which sportsmen try to put her,—a haggard, or adult peregrine falcon, shot somewhere on our coast

generally shot on sight. If this bird were put in a cage, he¹ would dash against the wires with the strength that only a hawk displays, and speedily kill himself or, at any rate, break most of his feathers. Instead, he is provided with a ruffer hood, consisting of a cap of leather tied on by thongs in back, and having an opening in front so that the bill and nares are outside. All hoods must fit properly, not too snugly or too loosely and must be of the proper shape to give a good fit at the bill opening. Jesses are put on the bird's legs. They consist of two light straps of leather, one of which is fastened around each tarsus. Both are joined to a com-

¹In this account of the training of a hawk the term *he* has been used, because the bird described in this article is a male. The female is, however, usually preferred by the falconer because of the larger size and greater power of hawks of this sex.



Photograph by Frank B. Levy

THE FALCON'S EYRIE

Female incubating on the face of a four-hundred-foot cliff

mon swivel through which the leash is passed. The tiercel is tied to a perch or block by the leash, but special precautions must be taken to prevent tangles that would cause injury. Thus equipped, the bird will probably sit quietly after a while, due to the hood, and may then be placed gently on the glove and carried around steadily, so that he may become accustomed to that position as soon as possible. A great falconer once said that a hawk should know no other perch than the master's glove, and that applies especially to the early part of the training.

It is difficult to understand why the mere act of carrying the bird has so great an effect, and I remember well how puzzled I was when in the early stage of my experience I took a falcon on a long railroad trip and noted how tame she became as a result of my carrying her on my fist all the way. The fact is, this persistent carrying is the great secret of discipline, and cannot be disregarded. Of course, if you can get somebody else to do this part of the work for you, all the better.

It is to be assumed that the hawk was hungry when caught and he should therefore be fed as soon as possible, and through the hood at first. To accomplish this, take a slice of lean steak and, still holding the bird on the left fist, touch him on the shoulder with the right hand and, when he strikes out defiantly at the air, endeavor to have the steak in the way. Sooner or later he will know what to expect and even reach out for more after swallowing a few pieces accidentally, provided of course that everything is done very quietly and gently. Now, when he has learned to eat well through the hood, either chirp or whistle when he is in the act of swallowing, and you will find that in a

remarkably short time he will stretch forward for food whenever he hears that particular sound. This means that he has become convinced to some degree of your good intentions, and it is time to go a step further. The rufter must be changed for a common hood, one that has a plume on top to enable one to handle it and drawstraps in back so that it can be opened and closed easily. This hood should fit just right, a matter that usually requires some luck and a number of hoods from which to make a selection. The change must be made in absolute or approximately absolute darkness.

A time should now be selected when the pupil is quite hungry, having been deprived of an appreciable meal for twenty-four hours; then, some appetizing but rather durable food under his feet, he should be unhooded in a room with a candle at the far end. Walk toward the light, keeping an eye on the hawk; if all goes well, the bird may be taken into practically full daylight at the first attempt. Either hood the bird or get back into darkness before the meal is finished; and be careful not to let the hawk feel he is being held a captive until much later.

It is a good plan at about this stage to break the bird to the hood, and the only way to do this is to take him into a dimly lighted room and hood and unhood him for hours at a time. He must become accustomed to being handled, especially about the head; his displeasure may be somewhat offset at first by occasionally giving him a morsel of food while continually stroking and hooding him. This part of the training is probably the most tedious of all, but it must be persevered with until the pupil will allow himself to be handled and hooded without alarm.

Meal times are the proper occasions for making progress. At first my tiercel was unhooded by artificial light, then outdoors in the twilight, and so, progressively, until he would feed on the fist quietly in broad daylight. It is well to prolong these meals, and to do so "tirings" are used, morsels that require hard work on the part of the



Photograph by Frank B. Levy

Female peregrine falcon, or duck hawk, a day or two after being taken from the nest, showing how tame these birds become even without training if properly handled. Attention is directed to the short wings and tail at this age

bird before they can be eaten. I found unplucked chicken wings the most useful for my tiercel; it would take him a good half hour completely to pluck and eat one. While the pupil is feeding absorbedly, he may be brought close to strangers and other new things with which he is to be made familiar. If his interest wanders too much from the meal and he shows uneasiness, his attention may be brought back by the familiar chirp or a tug at the food held in his feet. In this way he should be introduced to society as rapidly as he will allow; great care must be

taken never seriously to alarm him, but gradually to make him feel at home among human surroundings. He should always be hooded before the meal is finished, even at the cost of some minutes of training, for bating, that is flying off, on a full stomach is very bad. One should avoid giving the bird as much as he will eat, for it is all-important that he should have a good appetite each day even at the expense of some loss of weight, but anything even approaching actual starving is to be carefully avoided:

If all this is persevered in, it will be found that the hawk can be carried among people without causing him much alarm, that he will sit pretty quietly without the hood, and in fact gives every indication of having been manned. You must not expect too much, however, at this stage. He may be admirably behaved while occupied with something, but go into fits of bating as soon as his mind is free. For this reason it is a good plan to weather the bird at about this stage by placing him out on a block on the lawn and letting him bate off on to soft grass. Afterwards he probably will sit quite still on the fist.

The next step is to teach him to come to the fist for food. It is not absolutely necessary, but it certainly is a great convenience, to have the bird come willingly, and such willingness also serves as final proof that it is safe to put the hawk on the wing. Begin by allowing him to walk along a perch on to the glove for some tempting morsel. Next, place him on a polished rail, one of those that bend down at the ends. Hold the food a little away from the curved end; when he walks toward it, he is pretty sure to slip and flap to the glove. If the rail is not used, it is generally difficult to make him take

the first leap, but once that is accomplished, he will soon fly considerable distances to the glove. These lessons should be prolonged until he will come from a post outdoors, being still held by the leash of course.

It is now time to use the lure.¹ This should be conspicuously covered with food the first few times, and the pupil allowed to fly to it from a point each time increasingly distant, a string being attached to the swivel of the jesses for this purpose. The lure may be swung once or twice before being thrown down. After a few lessons the falcon will start for it as soon as it is brought out. Soon the string may be discarded, the swivel detached from the jesses, and the hawk flown free. Thus ends the work of training the wild caught falcon, the process of taking one of the wildest creatures in the world and making it gentle and amiable enough to do our bidding.

FLYING THE FALCON

I brought my bird to this point without much difficulty, the entire training taking about two weeks of constant work. It was a proud moment when I first saw him flying free overhead and, queerly enough, rather an anxious one, for the latter part of his training had progressed so rapidly that I had not been able to keep up with him myself. Consequently, I could not quite realize that it was perfectly safe to have him circling around overhead. I usually had an assistant hold him a few hundred yards away, then I would call him by swinging the lure, hiding it as he approached so that he would mount up and wing around.

It soon was evident that the falcon

¹The lure consists of a weight covered with leather, to which some pigeon wings are securely tied. It should be heavy enough so that the bird cannot move it. Thus he learns not to fly away with the quarry.



Photograph by George G. Goodwin

The hooded hawk on the block.—To the right of the block, in the foreground, is the lure

did not know how to pursue hard enough, in spite of being thoroughly proficient in flying,² and the lure was brought into play to remedy this fault. I would call him as usual, but as he came up to the lure, expecting to land upon it, I would jerk it quickly away so that he missed it. He would then swing around, looking for it, and come down again, keeping a little better watch on it than before. Soon he began to chase it, and in a few days it was almost impossible to keep it away from him for any length of time.

The hawk was then ready for serious flights at quarry, he was well trained and naturally pretty fast. Unfortunately, the surrounding country was very unfavorable for long flights, and there was no suitable game to fly. However, the bird had to be "made," so we obtained a common pigeon for the purpose.

The stoop of a game hawk is something that has to be seen to be believed. It has been known to cut the head clean off a grouse, and its speed carries the

²He was a young bird, hatched two weeks.

falcon past the fastest game bird as though it were standing still.

The main objective while training a bird for this sport is to get it to wait on at as high a pitch as possible. Peregrines generally will wait on readily enough. Hiding the lure for longer intervals each day teaches them that, but the attainment of altitude is often more troublesome. It depends a great deal on the individual bird, but there are many tricks used to obtain the desired end, such as rewarding the bird only when he comes from a height, or of having two people call him off, one standing on a hill while the other is on the level below. The bird is allowed to catch only the lower lure, and thus associates success with toiling up and coming swiftly down.

Eyesses, that is young birds, are employed more often in game hawking because of the greater safety attending their use when sent aloft to wait on. They must be properly handled, however, or they will be spoiled before they fly. They must not be taken from the nest until fully feathered and practically ready to leave. Installed in an empty room, or other warm dry place, they must be fed promptly. They generally will take food offered on the end of a pencil, provided it is handed them very quietly and every precaution has been taken from the first against frightening them. Soon they will crowd forward and feed from the hand freely; and they must be fed three times a day punctually.

They have to be liberated for a few



Photograph by Frank B. Leff

The bird has just caught the lure in the air and is prepared to eat the food tied to it. Note the firm grasp of the feet on the supposed quarry and the bell on the leg



Photograph by Frank B. Levy

Trained hawks are offered a bath every day. They bathe while being weathered on the lawn and afterwards fly up on the block to preen and dry. Note the padded top of the block and the leash, jesses, and swivel

weeks in order that they may become strong on the wing. This is called hacking, and the way it is done is as follows: The birds, let us assume, have become accustomed to eat at certain hours; they should now be fed on lures at these times until they come to know the lures. Then they should be freed early some morning with the lures in sight and a very light feed on them. After eating, the hawks will fly up on a neighboring tree or roof,

probably not going far at first. At the accustomed hour the lures should be brought out again and the hawks will find them. Once the birds have come back to feed, they will always return on time if they are able to, but it is very important to be punctual with the food. It must be tied on so that it will not come off. If it becomes detached, the hawk will fly away with it, and thus learn the dangerous habit of carrying. If a trained hawk flies

away with her kill, there is no way of getting her back, so one of the most useful lessons that the birds learn at hack is that food must be eaten on the ground.

They are very pretty to watch at this stage. They daily take long flights about the country, sometimes circling way up almost out of sight and again chasing each other playfully, making seemingly vicious stoops at one another from tall tree tops.

They do not know at first that birds are good to eat and thus rely on the lures, but some day they will discover this fact, and when they do, they must be taken in promptly. You can generally tell if this has happened by a missed meal, the safe period for leaving a peregrine at hack being about a month. A trap or snare must be used to recapture the bird. I found a No. 0 steel trap very heavily padded to be

excellent, but the conventional thing is the bow net. The training from this point on is the same as for a wild bird, although somewhat easier.

The great danger of hacking, is of course, that the birds may be shot; in fact, it is almost a certainty in most parts of the country, in spite of everything you can do to protect them.

To sum up, I can say that falconry is feasible, although difficult for the beginner, and that it offers a rare opportunity to make the acquaintance of a noble bird. I do not wish to persuade anybody to attempt it unless he happens to be exceptionally located, but I might say for the benefit of any such person, that the best book on the subject is *The Art and Practice of Hawking* by E. B. Mitchell, and that all equipment may be obtained from Mr. K. Möllen in Valkenswaard, Holland.



Photograph by Frank B. Levy

A hawk photographed in flight

With Murphy to Peru¹

By R. E. COKER

Professor of Zoölogy, University of North Carolina

THREE thousand years have passed since an elderly "preacher" of unusual wisdom complained that there was no end to the making of books; yet, of all the books that could have been in Solomon's library, those that survive today, if suitably translated, could doubtless be read by one of us in the course of a year. It piques our curiosity to know what may have been in the others, what even were their titles and subject matter. Our curiosity might be excited as well by the vast majority of the books now made each year, concerning which we must remain as ignorant as we are of the mass of the literature of King Solomon's time. We can scarcely read even the greater number of the current books that relate to subjects in which we have some real interest. Consequently, with reference to any new volume from the press, it is a question of the first importance: Is it worth while to spend time upon this particular book? Will it instruct us, or amuse us, or, by taking us easily away into infrequently trodden fields, refresh and invigorate our drooping minds? Tastes differ in reading as in friends but, for a wide class of readers, Murphy's *Bird Islands of Peru* will undoubtedly meet at least two of the criteria just mentioned.

Doctor Murphy is fortunate in his command of the English language. With no labored attempts at a particular manifestation of style and no rigid order of procedure, he speaks naturally and of the things that he saw and knew something about. He seems to be guided not so much by good judgment as by a happy instinct

in the selection of subjects and in the choice of words to make us see things very nearly as he saw them.

He takes us almost immediately to "The City of Kings," but we get no hackneyed description of streets and churches and plazas. If we depended upon Murphy alone, we might never know that there were such things in Lima as a Plaza del Armas or a Palacio del Gobierno. Murphy does not plagiarize the guidebooks. He does take us up on the hills of San Bartolomeo and Morro Solar, whence through his eyes we view the fine panorama of Lima on its sloping coastal terrace, beneath the high-banking Andes. We trace the strange "fog line" by the green or dusty aspects of the nearer slopes, or we turn to observe the sweeping Humboldt Current beyond the heights of San Lorenzo and cathedraled Pachacamac. The crimson sun sinks beneath the Pacific, the tropical sky darkens quickly, and we stand shivering in the cool sea breeze. Incidentally we learn quite a bit about the peculiar climatic conditions that make Lima, and all western Peru in fact, a region unlike any other.

Soon we are in voyage for the guano islands, and first, of course, the historic Chinchas. Thereafter we follow our guide and interpreter to the islands of chief interest—San Gallan, Isla Vieja, Asia, Pescadores, Guafape, Lobos—all alike in being generally dry, inhospitable to plant life, and the homeland of innumerable birds, but notably diverse in size, in height, and in general aspect, as well as in the character of the bird life. Penguins, pelicans, petrels, gannets,

¹A review of *Bird Islands of Peru* by Robert Cushman Murphy; published by G. P. Putnam's Sons, 1925.

gulls, and guanayes—these and many others come in review in their home life or in their wanderings over the sea for food. Through pictures, verbal or photographic, we see them, singly or by “acres,” resting on the islands, soaring in the air, or floating on the water, plunging, diving, or, as it seems, dancing on the waves. Occasionally, we leave the birds and boats and ramble on the mainland shore.

Interspersed with the chapters of narrative are an approximately equal number relating to special topics. In the chapter entitled “Ancient People of the Coast,” the author does not depart materially from his plan of restricting the story to matter that fell within the scope of his own personal attention. We find, therefore, not an historical or archaeological study, but a brief account of the author's observations in burial grounds near Pisco and in the notable museum of Doctor Prado y Ugarteche in Lima. The topic, though lightly touched, serves a useful purpose as a suggestive background for the picture that is being developed in our imagination—a picture of a region and an industry, unique in many respects, a picture that will be complete only when we view the present in the perspective of the past.

The Humboldt Current in its special chapter receives a different form of treatment; for the author presents an account of this phenomenon based upon all that has been discovered and reported, including observations of his own. Here we have the best general readable account of a great ocean stream, less in breadth and in volume than others of the major currents of the seas, but more majestic than any other, because more directly observable and more completely dominating coastal conditions. Practically

nothing about Peru, its appearance, its climate, its industries, or its society, can be comprehended without reference to the Humboldt Current and the oceanographic conditions associated with it.

A somewhat cynical American whose personal geographic experiences were very limited, once said that association with the Andes seemed to affect all travelers alike with a tendency to “tall” statements. It might better be said that familiarity with the Andes and with the adjacent Humboldt Current makes one aware of realities that can be reported only in language that may seem “tall.” If this is not the case, then the camera is as readily corrupted by the evil influences of natural phenomena as is the human eye or tongue. Actually, as the reviewer from his own knowledge can testify, Murphy does not incline to exercise the fullest privileges derived from his associations, but is conservative and desirous to substantiate rather than to startle.

The book is abundantly illustrated with photographs, chiefly, but not exclusively, of birds and colonies of birds, and these reveal the author not only as successful in handling the camera under a variety of conditions, but also as having an instinct for the point of view. Incidentally, some of his photographs give eloquent testimony as to the wisdom and the effectiveness of the Peruvian government in conserving and fostering the great national resource represented by the birds of the guano islands. To one who visited the same places about two decades before, many of the author's pictures have an entirely familiar aspect, but the broad sea of snowy piqueros shown on the south island of the Guañapes could not have been found there or

elsewhere in 1907. The most abundant, and potentially the most valuable bird of the coast, seems to have changed its nesting habit in a desirable way under the benign influence of a modern regime; or, more likely, it has resumed an original habit which it had long abandoned under force of unfavorable circumstances.

From what has been said of the general tone of the book, it may be inferred that Murphy gives us no general description of the Peruvian people, thus avoiding that fearful vice of so many temporary sojourners in strange lands. Through Murphy we are introduced to a number of Peruvians of both indigenous and acclimated stocks, and we meet them as we might if we were there, merely as the good friends who aid us in our travels in every practicable way, for such they are to those who approach them as good friends.

We meet among others "an ancient Indian" whose dignity and courtesy make him "a man to remember." "During subsequent association with the fishermen of Northern Peru—particularly with Indians from settlements between San José and Sechura Bay," says the author, somewhat incidentally, "I found every man kindly, hospitable and trustworthy." Such people should be reformed. The 1926 models of automobiles and fashion plates and novels might well work wonders with them. But how shall we get such things to them? These people seem to have been more or less exposed for several centuries to the ideas of European origin, without the infection taking so strongly as to alter essentially the character, the habits, and the point of view that were native to them. We refer to the indigenous coastal Peruvian fisher-

men, who have probably been changed little by either Europeans or Incas, not to the "higher powers" who have pioneered in aviation and who have recently given us an example of judicious conservation that would be noteworthy anywhere in the world and that, it may be hoped, will be as effective as the system of conservation that, it is said, prevailed on the same islands five centuries ago.

There remains to fulfill the manifest destiny of all reviews, namely, to point out the glaring defects of the book in hand. Unfortunately for our salvation as a reviewer, the defects did not glare as we read. No doubt they are there and we missed them only because we were too soon deluded into thinking of the author as our host. We ought to go back and search them out, but we hesitate to abandon our delusion. So we lay aside the book for a time, feeling that Murphy has really taken us with him to the islands, waters, and coastal regions of Peru. We have not read a textbook, nor a tale of adventures, nor a catalogue of curiosities and natural history; but we have had a fascinating voyage, and we have become pleasantly acquainted with a region that is notably different from all others that we may have known before. We find it a real place, nevertheless. Whatever may be the seeming anomalies of climate, of natural phenomena, of human history, Peru fits into our world better than before. Unconsciously we may have enlarged somewhat the sphere of our imagination to take in comfortably the shores of the Humboldt, but, at any rate, we did not have to conceive a new world with unique laws to provide place for a region that blends so much of incongruity with a genuine charm.

Ernest Harold Baynes

BORN MAY 1, 1868; PASSED INTO THE GREAT BEYOND
JANUARY 21, 1925

By FREDERIC A. LUCAS

Honorary Director, American Museum

IT is a simple matter to write a eulogistic notice of some prominent man one has never met, but to write of a friend is different, and anyone who knew Mr. Baynes would feel that whatever might be written would seem cold and perfunctory.

Born in Calcutta in 1868 and passing his boyhood in England, he came with his family to the United States and was graduated from the College of the City of New York, where he acquitted himself well both in scholarship and athletics.

For a short time he tried reportorial work on the *New York Times*, and for some years he assisted his father in his work on the application of photography to modeling, and then, in 1900, took up what was to be his life work: writing and lecturing on natural history and especially on the animals found about our homes.

He was one of those who have the rare gift of making friends with wild animals and some of his experiences may be found in his last book—*The Sprite, the Story of a Red Fox*—though his most popular work is probably the history of Jimmie, the mischievous but most amusing and lovable black bear.

Living as he did near the great Corbin game preserve in New Hampshire at the foot of Croydon Mountain, he had an opportunity to make the acquaintance of some unusual animals. Among other things he broke to harness a pair of bison, though few of his friends really enjoyed a drive behind them as they were given to indulging in little wayside excursions on their own initiative which, though quite good-natured, were sometimes rather startling. Probably this acquaintance with the bison caused him to take a keen interest in their preservation and ac-

counted for the prominent part he took in founding the American Bison Society.

He was naturally fond of dogs but these, as well as his wilder friends, did not always show the same consideration for others that they did for Mr. Baynes. Some of his "pets" indeed could hardly have been beloved by his neighbors whose hens and sheep fell victims to them and, in view of the damages he was now and then called upon to pay, his friends were wont to chaff him with the remark that his pets were certainly *dear* to him if not to his neighbors. It speaks volumes for Mr. Baynes that in spite of these depredations he continued to hold the esteem of the villagers.

His keen sense of justice led him to devote much time during the last years of his life to protests against the misstatements of the so-called antivivisectionists, protests that were financially costly to him, for thereby he lost many thousands of dollars in the way of lectures. But it won him the support of medical men throughout the country and led to the founding of the association of the Friends of Medical Progress (now the American Association for Medical Progress). We all have an admiration for martyrs, however little we may wish to play the rôle ourselves.

When Mr. Baynes was stricken down, he was about to begin the book he had planned on *Animal Heroes of the World War*, and to this he devoted literally his last energies, completing the final chapter on the very afternoon he died. He might well have concluded with the words of Paul "The time of my departure is come. I have fought the good fight, I have finished the course, I have kept the faith."

NOTES

ASIA

THE THIRD ASIATIC EXPEDITION OF THE AMERICAN MUSEUM AND ASIA MAGAZINE.—The largest expedition in which the Museum has ever participated will start from Kalgan, the gateway of Mongolia, shortly after the middle of April, headed for Tsagan Nor, the westernmost point previously reached by Mr. Roy Chapman Andrews and his co-workers. Proceeding thence northwestward into new territory the expedition, will apply all the expert knowledge of the members of its personnel to the scientific conquest of this area. Included in the party besides Mr. Andrews, who for many months has been in the East carrying out with consummate care the bewildering number of details essential to success, are: Mr. Walter Granger, paleontologist and second in command; Dr. Charles P. Berkey, professor of geology at Columbia University, who serves as geologist; Mr. Frederick K. Morris, previously of Columbia University and Peyang University, assistant geologist; Major L. B. Roberts, topographer, who during the War was a member of the U. S. Aerial Mapping Force in France; Lieutenant Butler, assistant topographer; Lieutenant Robinson, assistant topographer; Dr. Ralph W. Chaney, botanist and paleobotanist of the Carnegie Institution of Washington; Mr. N. C. Nelson, associate curator or archaeology in the American Museum; Mr. Clifford Pope, assistant in zoölogy; Mr. George Olsen, discoverer of the first dinosaur nest; Doctor Skinner, surgeon; Mr. J. B. Shackelford, cinematographer; Mr. J. McKenzie Young, in charge of motor transportation; Norman Lovell, assistant in motor transportation.

Messrs. Young and Lovell have charge of a fleet of five Dodge cars and two Fulton trucks, and, as in other years, the maintenance of this equipment at the maximum of efficiency may safely be entrusted to Mr. Young and those working with him. At Kalgan one hundred fifty camels have been assembled for the transport to Tsagan Nor of the supplies, which in addition to flour and rice and similar food-stuffs, include all the other necessities for a sojourn of five months in the desert.

Besides the scientific and administrative personnel just listed, the party will include ten Mongols under the veteran camel driver Merin and about an equal number of Chinese, con-

sisting of a No. 1 boy, three cooks, taxidermists, fossil collectors, and chauffeurs.

THE PINK-HEADED DUCK.—When the Faunthorpe-Vernay Expedition set forth in 1922 to collect for the American Museum specimens of the rapidly disappearing fauna of India, one of the most desired objects of the quest was the nearly extinct pink-headed duck. This bird secretes itself in the dense swamps and both because of its rarity and the obstacles presented by its habitat is very seldom seen. Some years ago a specimen was shot on the Nepal border north of Oudh, and two specimens were taken respectively in the Shahjahanpur District and in the Kheri District, but in spite of the most painstaking search the expedition of 1922-23 failed to see a single bird, and persistent inquiry among local *shikari* brought only the disappointing reply "The bird has not been seen."

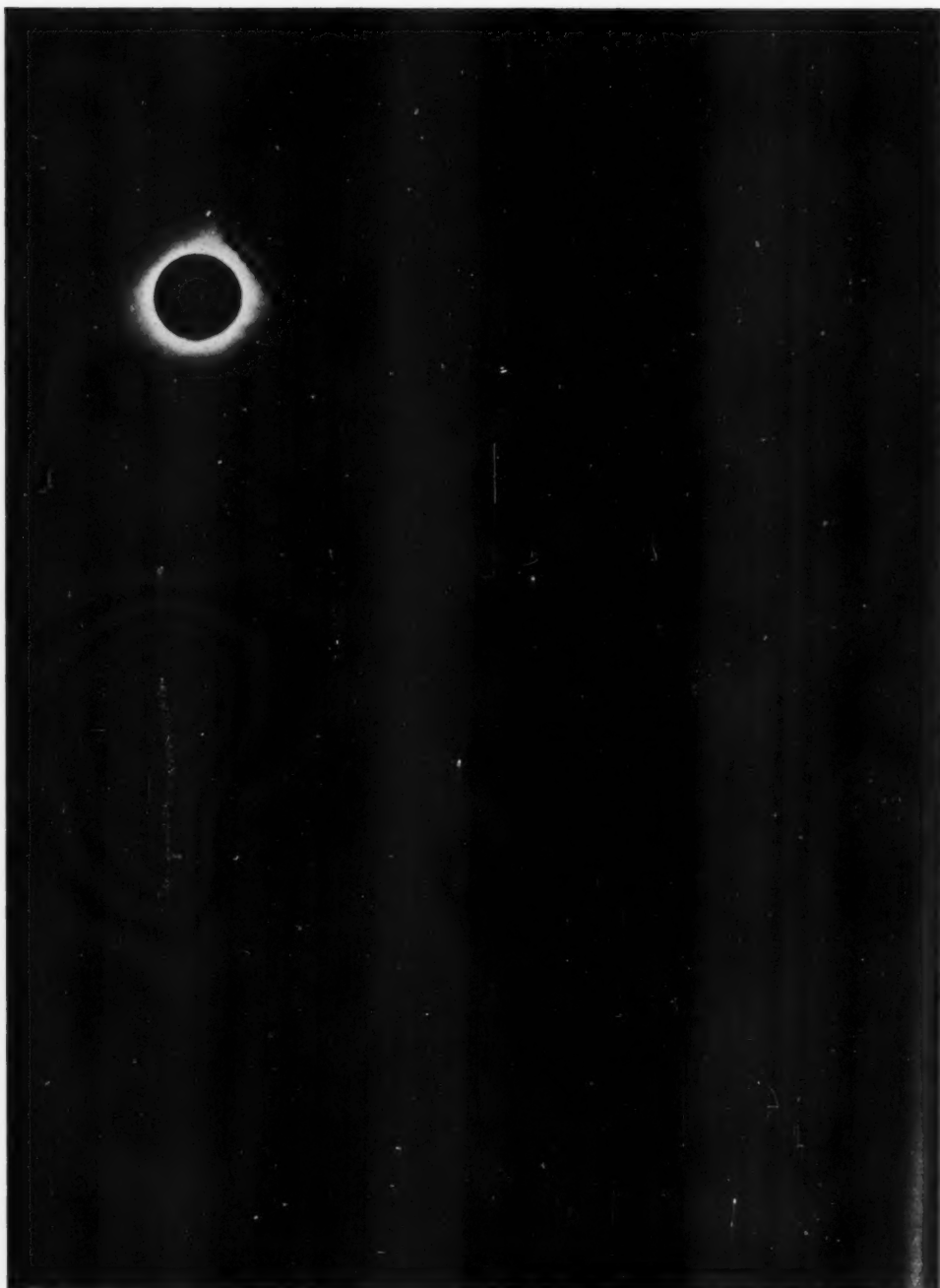
Ever solicitous of the Museum's needs, Mr. Vernay took the precaution, however, before leaving the Nepal region to commission a local hunter to keep on the watch. That was two years ago; now news comes from Mr. Vernay that the prize has been bagged,—two specimens secured in north Kheri.

NEW YORK ZOOLOGICAL SOCIETY

THE EXPEDITION ON THE STEAMER "ARCTURUS" for the investigation of the Sargasso Sea and other tropical oceanic areas under the leadership of Mr. William Beebe of the New York Zoological Society, sailed from New York on February 10 and after stopping at Norfolk, Virginia, to coal, proceeded to Bermuda, its final stop on the way to the first scene of its operations. The expedition has been made possible through the generosity of a number of contributors, the principal ones including Messrs. Harrison Williams, Henry D. Whiton, Vincent Astor, Marshall Field, Clarence Dillon, George F. Baker, Jr., and the American Museum of Natural History.

President Henry Fairfield Osborn of the Museum accompanied the "Arcturus" as far as Norfolk, and reports from Bermuda and by wireless from the Sargasso Sea itself indicate that interesting finds are being made.

Few scientific expeditions have been more carefully prepared in respect to material equipment or a scientific and technical staff



Photograph by G. Clyde Fisher

SOLAR ECLIPSE OF JANUARY 24, 1925

The picture was taken during totality from the Jumel Mansion at 160th Street, New York City. The following equipment was used: a Graflex camera with a Cooke lens, f.4.5, focal length 7 inches, stop f.16, Kodak Cut Film. The time of exposure was two seconds

better qualified by previous experience, training, and proved accomplishment to take advantage of the opportunities that the voyage will afford for oceanographic and biological studies of all kinds. It is equipped, not only for obtaining data as to the ocean itself and the collection of specimens of animal and plant life, but for studying this marine life under natural conditions, and for recording by photographs, moving pictures, and colored drawings and paintings made by scientifically trained artists, the true colors and appearance of these creatures in life and in motion.

The director of the expedition, Mr. William Beebe, as ornithologist, author, explorer, and director of the New York Zoological Society's Tropical Research Station in British Guiana, needs no introduction to the readers of NATURAL HISTORY. The American Museum has furnished a member of its scientific staff, Dr. William K. Gregory, curator of the department of comparative anatomy and professor at Columbia University. Other members of the expedition are Miss Lillian Kopeloff-Segal, biological chemist, late of the Health Department of New York City; Dwight Franklin, assistant in fish preparation; Charles J. Fish, of the United States Bureau of Fisheries, specialist on diatoms and crustaceans, and his wife, Dr. M. D. Fish, assistant in larval fish distribution; Miss Isabel Cooper, artist; John TeeVan, scientific photographer; Ernest Shoedsack, moving picture expert; Miss Ruth Rose, historian and technician; William H. Merriam, in charge of the mechanical equipment; Dr. D. W. Cady, surgeon; Jay F. W. Pearson, assistant in macroplankton; Hugh Raup, assistant in microplankton, and Serge Chetyrkin, Russian zoölogist and botanist, as taxidermist of the expedition.

The plans of the voyage provide for a trip of about six months. After a study of the Sargasso Sea the "Arcturus" will pass through the Panama Canal and continue its work in the region of the Humboldt Current in the Pacific.

RECENT CONTRIBUTIONS FROM THE NEW YORK ZOOLOGICAL SOCIETY.—Under the splendid sanitary conditions obtaining at the New York Zoological Park the animals, protected from predacious enemies, enjoy a longevity probably rarely attained under natural conditions; but, in so large a population, deaths are inevitable in the normal

course of things, and, when they occur, the animals are sent to the American Museum as anatomical specimens.

Among the great variety of animals thus received during the past few months are several of exceptional interest.

The most noteworthy specimens donated to the department of herpetology include an African smooth-clawed frog (*Xenopus laevis*), a dwarf monitor (*Varanus caudolineatus*) from Australia, an iguana (*Conolophus suberistatus*) captured by Mr. William Beebe in the Galápagos Islands, a Cuban boa (*Epicrates angulifer*), and two red rattlesnakes (*Crotalus exsul*) from California.

Several very desirable birds have been received, among which may be mentioned the six-plumed bird of paradise (*Parotia sefilata*), an adult bald eagle, captured at Peekskill, New York, several interesting pigeons from the Notogean, or Australian, region, a maguari stork (*Euzenura maguari*) from South America, and a particularly fine specimen of Burmeister's seriema (*Chunga burmeisteri*) from the Argentine, where it is locally known as "chunnia." This is one of the most peculiar and interesting of living birds and has long been a puzzle to naturalists. Sharp classified it with the birds of prey, but more recent investigators believe that it is more closely related to the Gruiformes, or the crane-like birds, including the bustards. It has been mounted and will be the first of its kind to be exhibited in the American Museum.

The mammals presented to the Museum by the New York Zoological Society are no less varied than the reptiles and birds. They are represented by specimens from all the continents and include members of very divergent groups. Among them are the following: a red-faced saki monkey, or red ouakari (*Cacajao rubicundus*) from the Amazonian forests of South America, a mandrill (*Mandrillus*) from West Africa, a prehensile-tailed porcupine (*Candou prehensilis*) from South America, a rare species of armadillo (*Cabassous unicinctus*) captured by Mr. William Beebe in British Guiana, a hyrax (*Procapra capensis*) from South Africa, and an aard-vark (*Orycteropus aethiopicus*) from Abyssinia. This queer animal was the first of its kind ever received at the Museum in the flesh. Casts were made of the external features of the animal before its skin and skeleton and some of the soft parts were preserved. The aard-vark is not closely related to any other living

animal. It was consequently removed from the Edentata and at the present time constitutes a separate mammalian order, the Tubulidentata.

Some of the material from the Zoological Park has been preserved entire for anatomical purposes, and forms a very valuable part of the collection of the department of comparative anatomy.

The various departments of the Museum are very fortunate in being favored with such a wealth of material by the New York Zoological Society.

The responsibility for selecting and preserving the anatomical specimens donated has devolved largely upon Mr. H. C. Raven, assistant curator of comparative and human anatomy, and his proficiency and technical knowledge in this field has recently received recognition through his appointment as associate prosector of the New York Zoological Society. He will henceforth share responsibilities heretofore carried solely by the prosector, Doctor Huntington, of the College of Physicians and Surgeons.

THE VERNAY ANGOLA EXPEDITION

To obtain a fine selection of big game for the American Museum's new Asiatic hall has long been one of President Henry Fairfield Osborn's ambitious projects. His high expectations were suddenly realized by the many priceless gifts from Mr. Arthur S. Vernay. As a result of Mr. Vernay's special expeditions into tropical Asia, partly with Col. J. C. Faunthorpe, a series of the most representative groups of wild life is now being prepared for exhibition in the Museum studios under the direction of Mr. James L. Clark.

Mr. Vernay's loyalty to the American Museum and his generosity in undertaking extensive and hazardous field work on its behalf is being strikingly demonstrated in the organization of a new expedition, of which this institution is to be the beneficiary. Mr. Vernay has selected, as a new sphere for his exploits, Portuguese West Africa. This time the habitat of the Angola sable antelope (*Hippotragus varians*) will become his hunting ground. Among the larger antelopes there are hardly any of prouder carriage or more spectacular appearance. The large, scimitar-shaped, rough horns reach a length of sixty-four inches. The glossy dark brown, nearly black, upper side and white under parts of the bull, as well as the presence of nuchal and throat

manes, render it a most conspicuous animal.

The Vernay Angola Expedition will endeavor to make its stay as useful to science as possible through general collecting, for among African regions there could be found few of greater interest. In Angola representatives of the West African, East African, and South African faunas meet. There is a fair variety of game but it is rather scarce. Success in this field will be assured chiefly by Mr. Vernay's fine marksmanship. In addition to mammals and birds, reptiles, fish, and invertebrates will also furnish many interesting data. In view of the fact that there are practically no natural history collections from this region represented in any of the American institutions, Mr. Vernay has decided to have a biological survey made across the country. Several of the Museum departments have taken an active interest in rounding out the scope of this undertaking.

Messrs. Herbert Lang and Rudyerd Boulton, both of the Museum staff, the latter an ornithologist who accompanied Mr. Ludlow Griscom on his recent expedition to Panama, will leave New York on March 14 and a month later will start active field work in Angola near the coast and along the railroad. Toward the middle of June Mr. Vernay will join them and the party will then proceed into the interior. The entire results of the Angola Expedition will be donated by Mr. Vernay to the Museum. Messrs. Vernay and Boulton will return to New York in October. Mr. Lang expects to continue his field studies two months longer by traversing South Africa.—H.L.

IN MEMORIAM

THOMAS LINCOLN CASEY, an authority in the taxonomy of the Coleoptera, died on February 3 in his sixty-eighth year. Born in 1857, he was graduated from the U. S. Military Academy in 1879, and was an officer in the U. S. Army, retiring from active service in 1912. His voluminous contributions to our knowledge of the Coleoptera began in 1884 and continued for forty years. They appeared at first in various scientific journals and, since 1910, in memoirs privately printed. They consist of descriptions of new species or forms, usually coupled with systematic treatment of the group involved, and aggregate 8621 closely printed pages. Opinions as to the permanent value of Casey's work differ. To many coleopterists the forms which he sometimes described as "taxonomic units" appear to be

undeserving of names; and reviews of his work in certain groups have relegated some of the names he proposed to synonymy. On the other hand, a great part of his work was done on families of minute beetles, which had been in part neglected by previous authors, and where his power of systematic analysis is displayed to advantage. The large number of new names he proposed resulted from his untiring perseverance in studying the great collection he had accumulated, and which, with his valuable and extensive library, he bequeathed to the U. S. National Museum. While many of such names may ultimately be considered unnecessary, enough will remain in our catalogues to make their author one of the greatest coleopterological taxonomists.—CHARLES W. LENG.

BIRDS

DR. ROBERT CUSHMAN MURPHY, associate curator of marine birds, who represented the American Museum at the Third Pan-American Scientific Congress in Peru, was one of eleven delegates upon whom the University of San Marcos at Lima conferred an honorary degree. In a graceful address of thanks Doctor Murphy expressed his gratification at being included as Doctor Honoris Causa among the distinguished sons of the South American institution, the founding of which dates from a time long before the birth of learning in the territory now occupied by the United States.

CONSERVATION

THE SAVE THE REDWOODS LEAGUE.—About two hundred fifty miles north of San Francisco on the Redwood Highway are Dyerville and Bull Creek Flats,—groves which have been pronounced by competent judges the finest examples of coast redwood to be found. Many of the trees in these groves are two thousand or more years old, giants of the plant world that tower to a height of as much as 375 feet and have a girth of from 30 to 45 feet. The Save the Redwoods League feels that these superb trees must be preserved, to the lasting benefit of Humboldt County and of the thousands of visitors who in the course of the years will find inspiration in their stately beauty. The two tracts in question are essential to the rounding out of the present fourteen-mile strip along the highway known as the Humboldt State Redwood Park. Fortunately funds are available for their acquisition, and the hearty concurrence of the Board of Super-

visors of Humboldt County in the purposes of the League should be helpful in consummating the negotiations for their purchase now believed to be impending.

SCIENCE OF MAN

THE MRS. WILLIAM BOYCE THOMPSON.—ARCHÆOLOGICAL EXPLORATION OF THE LOWER GILA RIVER, ARIZONA.—The beginning has been made of what promises to be a thorough examination of ancient remains in the region drained by the lower Salt and Gila rivers. Nowhere else in the United States are there indications of irrigation systems so extensive or of such a dense population. An intricate series of ditches furnished water for large tracts of land in the vicinity of Phoenix and Florence, Arizona. The modern ditches in the vicinity of these cities are in many cases the ancient ones cleaned out. In prehistoric times there were considerable cities in this region, the walls of some of which are still standing. Both the irrigation canals and the buildings were examined in 1887-88 by the Hemmingway Expedition of Harvard University led by Frank H. Cushing. Unfortunately but meager reports of this work were published. One well-preserved ruin, Casa Grande, is now under the protection of the National Park Service of the United States Government.

Scattered about in this general region are many ruins small and large and of varying ages. Several of these are situated near mountain valleys where irrigation was not necessary for the raising of maize. One of these, near the state highway between Globe and Superior, Arizona, was recently visited by Dr. P. E. Goddard, curator of ethnology, American Museum, and has been chosen for complete excavation. There are in this ruin about a hundred rooms as indicated by remains of walls of stone. Already a skeleton in fair preservation has been recovered, besides pottery and ornaments of shell and turquoise.

In the neighborhood are well preserved cliff ruins, which have not suffered from vandalism. These will no doubt supply specimens of great scientific value. In one large cave there is a room that has its roof intact and well preserved. The very arid condition of these caves has assured the survival of textiles and other objects which have disappeared in the unprotected ruins.

It is through the interest of Mrs. Thompson, wife of the well-known philanthropist and

mining man, Col. Wm. Boyce Thompson, that the American Museum is able to undertake this important work. Mrs. Thompson some years ago provided for archaeological research in Cyprus; and during her travels in Egypt, Peru, and elsewhere has become interested in early civilizations.

A thorough study of the region should throw light on the connection between the prehistoric people of the Valley of Mexico and those who lived and developed a civilization in pre-Spanish times in the region of the Upper Colorado and Rio Grande rivers.

THE INSTITUT DE PALÉONTOLOGIE HUMAINE, which, generously endowed by the Prince of Monaco, has become one of the principal agencies for contributing to the knowledge of early man, announces a spring course of lectures of unusual interest: "L'Aurore de la Pierre taillée" by M. H. Breuil, "Origine et Formation des Grottes utilisées par l'Homme paléolithique" by M. A. Viré, "L'Art quaternaire dans le Pays basque" by M. Passemard, "Découverte du Paléolithique en Chine" by M. P. Teilhard de Chardin, "Une Population primitive actuelle: le Pygmées" by M. R. Verneau, "Les Origines de l'Homme américain" by Doctor Rivet.

NEW MEMBERS

Since the last issue of *Natural History* the following persons have been elected members of the American Museum, making the total membership 8179.

Fellows: MESSRS. ROLAND JACKSON HUNTER AND FRANCIS W. McMILLAN.

Life Members: MESDAMES FLORENCE SUTRO ESBERG AND MORRIS HAWKES; THE MISSES ELIZABETH McLANE AND ELLEN J. STONE; MESSRS. HENRY ESBERG, GEORGE E. CHISHOLM, EDWARD J. LAVINO, JEREMIAH MILBANK, W. H. MINER, HENRY M. SAGE, JOSEPH R. SWAN, WILLIAM H. VANDERBILT, ARTHUR T. WALKER, FRANK D. WATERMAN, AND ORLANDO F. WEBER.

Sustaining Members: MESDAMES C. G. RICE AND WHARTON SINKLER; DOCTOR DUDLEY ROBERTS; MESSRS. EDWARD BREVOORT RENWICK, CHARLES EDWARD RILEY, AND SIMON SIEGMAN.

Annual Members: COUNTESS MAUD SALM; MESDAMES CLARENCE E. CHAPMAN, DE WITT CLINTON FALLS, FRANCIS E. FAXON, ROBINSON LOCKE, CLARE FLORENCE MEYERS,

FREDERICK NATHAN, JOHN H. NOLAN, FERDINAND NUSBAUM, WHITELAW REID, RUSSELL E. SARD, FRANK HALL SCOTT, W. G. SHARP, KNOX TAYLOR, W. H. TOMBS, CHARLES H. TWEED, LUCIEN HAMILTON TYNG, ANDREW M. UNDERHILL, J. HOWARD WAINWRIGHT, ALFRED L. WHITE, GEORGE L. WOODWARD, AND OWEN D. YOUNG; THE MISSES MARGARET E. ASHLEY, MARY H. DENVER, RUTH GUERNSEY, ALICE E. KINGSBURY, MARY SUMNER PHRANER, EUNICE A. SCHOONMAKER, KATE R. SIMONS, AND ETHEL ZABRISKIE; MAJOR R. T. M. SCOTT; REV. DR. STEPHEN S. WISE; BROTHER HENRY; HONORABLE CORNELIUS A. PUGSLEY; DOCTORS CHARLES D. EASTON AND S. ORMOND GOLDAN; MESSRS. ROY S. BARNHART, JOHN HAVEN EMERSON, ROBERT E. FARLEY, UDO M. FLEISCHMANN, GERARD FOUNTAIN, W. F. FURST, NELSON AUGUSTUS GLADDING, H. H. S. HANDY, GERARD C. HEGERMAN, JULIUS A. HEIDE, WM. O'D. ISELIN, JOHN W. KISER, CARL H. LANGENBERG, JOHN L. LAWRENCE, ALEXANDER LEVENE, C. G. LUEDER, PIERCE MARION, E. A. MOORE, M. L. NEUMOEGER, WILLIAM MONYPENY NEWSOM, M. PATTERSON, CHARLES S. PAYSON, SIEGFRIED PEIERLS, JAMES H. PERKINS, WILLIAM Y. PETERS, CHARLES T. PLUNKETT, SAMUEL YOUNG RAMAGE, ROBT. RENNIE, H. N. RUST, K. B. SCHLEY, WILLIAM W. SIESON, A. M. SLOSS, DANIEL CRANFORD SMITH, CHARLES R. STANDINGER, GEORGE H. STORM, RAYMOND W. STORM, WILLIAM GEORGE SULLIVAN, WYLLYS TERRY, WILLIAM J. TINGUE, J. I. WAKELEE, ARVINE WALES, GUSTAVUS A. WALKER, CHARLES N. WELSH, AND LEONARD D. WHITE.

Associate Members: MESDAMES JOSEPH BRIDGHAM, A. S. COLEBROOK, ALASTAIR GORDON CUMMING, J. P. GARDNER, GEORGE HORATIO GORHAM, ELBERT A. HARVEY, HORATIO KING, AND MCCOOK KNOX; MISS GRETE WEBER; GEN. HENRY T. ALLEN; DOCTORS V. N. ROBB, ELDRIDGE M. SHANKLIN, AND CHAS. S. TULLER; MESSRS. WM. H. ALLEN, L. G. BARTH, C. BAUSMAN, G. E. CHAMBERLAIN, HARRY J. CHOPOURIAN, RUSSELL T. COSTELLO, J. MURDOCK DENNIS, CARL A. GARRIS, JR., CHAS. J. GROUP, ALEXANDER HAYS, H. L. HOLLIS, J. E. JACOBS, A. M. MCQUEEN, ALFRED E. MEYER, E. V. NEELANDS, ROBERT SCHUYLER OGDEN, MARCUS T. REYNOLDS, HERMAN SCHWARZ, REGINALD LE GRAND SWANN, W. A. THOMAS, ARTHUR T. WAYNE, CLAUDE S. WILCOX, FRED. C. WILHARM, AND JAMES ZETEK.